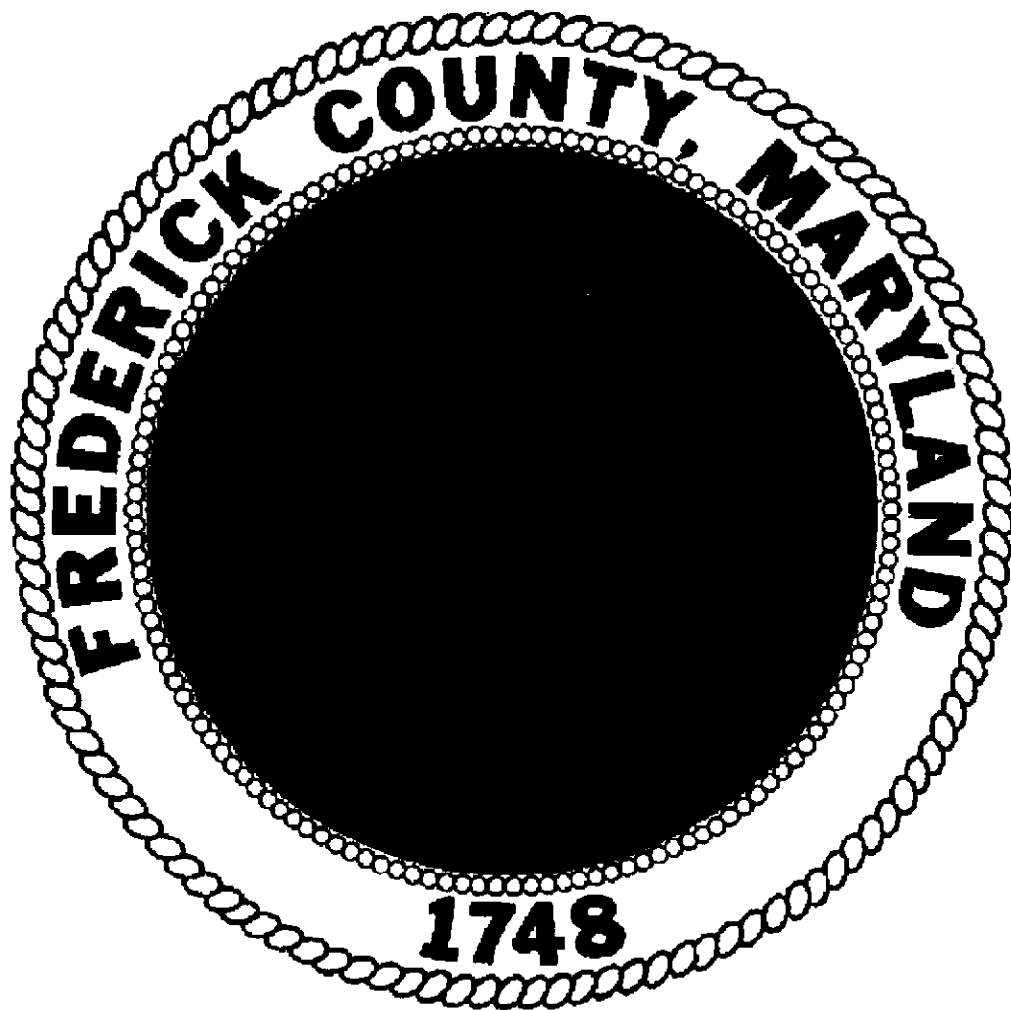


# DESIGN MANUAL FOR WATER AND SEWER FACILITIES



FREDERICK COUNTY  
DIVISION OF UTILITIES & SOLID WASTE MANAGEMENT  
DEPARTMENT OF ENGINEERING AND PLANNING

THE EFFECTIVE DATE OF THIS RESOLUTION IS JULY 20, 2006

RESOLUTION NO. 06-30

RESOLUTION OF  
THE BOARD OF COUNTY COMMISSIONERS  
OF FREDERICK COUNTY, MARYLAND

RE: Amendments of Standard Details and General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures; and the Design Manual for Water and Sewer Facilities

RECITALS

Pursuant to the authority contained in Chapter 2-13 of the Code of Public Local Laws of Frederick County, Maryland, the Board of County Commissioners is seeking to amend certain provisions contained in the following documents: *Standard Details for Water Mains, Sanitary Sewers and Related Structures* (originally adopted via Resolution 83-34 on December 13, 1983 with changes adopted via Resolution 96-05 on February 6, 1995); *General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures* (originally adopted via Resolution 83-34 on December 13, 1983); and the *Design Manual for Water and Sewer Facilities* (originally adopted via Resolution 94-07 on March 15, 1994). These amendments to the aforesaid document are necessary in order to compliment those requirements associated with the proposed Residential Sprinkler Ordinance.

In addition, the Board wishes to formally adopt and approve the text contained in the October 1991 document entitled "*Special Provisions*" to the *General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures*, which have been utilized by staff.

A public hearing was held on these proposed changes on July 18, 2006, at which time the public had the opportunity to comment.

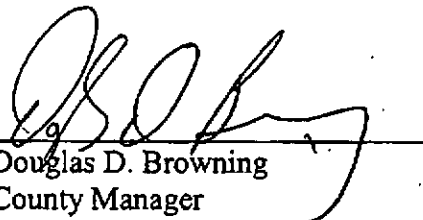
NOW THEREFORE BE IT RESOLVED by the Board of County Commissioners of Frederick County that the attached Exhibit A, is hereby adopted;

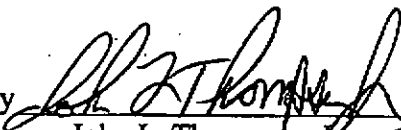
AND BE IT FURTHER RESOLVED that this Resolution shall take effect on July 20, 2006.

The undersigned hereby certifies that this Resolution was approved and adopted  
on this 20th day of July, 2006.

ATTEST:

BOARD OF COUNTY COMMISSIONERS  
OF FREDERICK COUNTY, MARYLAND

  
\_\_\_\_\_  
Douglas D. Browning  
County Manager

By  (SEAL)  
\_\_\_\_\_  
John L. Thompson, Jr.  
President

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The \$10.00 purchase price, along with the registration, entitles owners to at least three (3) years of revisions. If you have any suggestions for the improvement of this guide, or if you find errors, please write us at the address below.

If you would like to be placed on the mailing list of owners of the ***Design Guidelines for Water and Sewer Facilities***, please complete the registration form below and mail to:

Frederick County Department of Public Works  
Bureau of Water and Sewer  
Division of Engineering and Planning  
118 North Market Street  
Frederick, Maryland 21701

REGISTRATION FORM			
<i>Design Guidelines for Water and Sewer Facilities</i>			
NAME			
TITLE			
ORGANIZATION			
ADDRESS			
CITY		STATE	
ZIP (+9)			
PHONE			
FAX			
SIGNATURE		DATE	

THE EFFECTIVE DATE OF THIS RESOLUTION IS April 1, 1994

RESOLUTION NO. 94-07

RE: Design Manual for Water and Sewer Facilities

RECITALS

Pursuant to the authority contained in Chapter 2-13 of the Code of Public Local Laws of Frederick County, the Board of County Commissioners is seeking to adopt the *Design Manual for Water and Sewer Facilities* to establish standard design practices in an effort to better inform the development community of the County's expectations, thereby reducing staff review time and expedite the approval process.

In order to more efficiently utilize staff time the Board considers it appropriate to institute a design manual for those lots serviced by the Frederick County Department of Public Works, Bureau of Water and Sewer.

A public hearing was held on this proposed manual on February 15, 1994, at which time the public had the opportunity to comment.

NOW THEREFORE BE IT RESOLVED by the Board of County Commissioners of Frederick County that the attached Exhibit A, entitled *Design Manual for Water and Sewer Facilities* is hereby adopted.

BE IT FURTHER RESOLVED that this Resolution shall take effect on April 1, 1994.

The undersigned hereby certifies that the foregoing Resolution was approved and adopted on the 15th day of March, 1994.

ATTEST:

  
Dawn Hatzer  
Administrative Officer

BOARD OF COUNTY COMMISSIONERS  
OF FREDERICK COUNTY

By   
Ronald L. Sundergill  
President



Department of Public Works  
Bureau of Water and Sewer, Division of Engineering and Planning  
Frederick County, Maryland

DESIGN GUIDELINES FOR WATER AND SEWER FACILITIES

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## CHAPTER 1. — GENERAL

### 1.1. INTRODUCTION AND PURPOSE OF MANUAL

#### 1.1.1 Administration

1.1.1.1. Severability of Provisions: In the event it be judicially determined that any word, phrase, clause, sentence, paragraph, section or part in or of these regulations, or the application thereof to any person or circumstances is invalid, the remaining provisions and the application of such provision to other persons or circumstances shall not be affected thereby, it being hereby declared that the remaining provisions of these regulations without the word, phrase, clause, sentence, paragraph, section or part in or of these regulations, or the application thereof, so held invalid would have been adopted and approved.

#### 1.1.1.2. Conflict With Other Regulations

1.1.1.2.1. Whenever any provisions of these regulations conflict with any other provisions of law, whether set forth in these regulations, or contained in any restrictions covering any of the same subject matter, that provision which is more restrictive or imposes the higher standard shall govern.

1.1.1.2.2. Nothing herein contained shall be taken as restricting any control that the State Department of Health and Mental Hygiene and the State Department of Water Resources are empowered to exercise within Frederick County.

#### 1.1.1.3. Appeals

1.1.1.3.1. The Chief of the Division of Engineering and Planning is charged with the responsibility of interpreting this manual. Any deviations from the standards or criteria established in the Design Manual, which the engineer believes to be necessary for the completion of the design, are to be submitted in writing to the Chief. The deviations are to be clearly identified and accompanied with justifications why they are necessary. The Chief will respond to the deviation request in writing, either approving or denying the said request.

1.1.1.3.2. Written appeals of interpretations made by the Chief of the Division of Engineering and Planning, shall be sent to the Bureau Chief of the Bureau of Water and Sewer for a decision.

1.1.1.3.3. Written appeals of decisions made by the Bureau Chief shall be sent to the Director of Public Works.

### 1.1.2. General Planning

1.1.2.1. Objectives: The Water and Sewer Design Manual has been prepared to implement the goals, objective and policies contained in the *Frederick County Water and Sewer Master Plan*. Any private or public water and sewerage projects shall be required to be consistent with this Plan prior to beginning design and engineering. All projects also shall be required to have the appropriate Water and Sewer Plan classification on the most recently adopted Plan maps prior to design and engineering.

1.1.2.2. The general requirements, design criteria and engineering practices as found in this document shall be implemented to be consistent with any procedures or policies instituted in connection with the *Frederick County Adequate Public Facilities Ordinance, Zoning Ordinance or Subdivision Regulations*.

### 1.1.3. General Design

1.1.3.1. Objectives: The Water and Sewer Design Manual is intended to provide a summary of information, procedures, criteria and practices that are applicable to the undertaking of public water and sewer projects within Frederick County (County). The design criteria and engineering practices set forth in this manual with the latest revision of the *General Conditions and Standard Specifications for Water Mains, Sanitary Sewers and Related Structures and Standard Details* comprise the total requirements for design of outlines requirements for the design of projects that are to be included into County water and sewer systems.

1.1.3.2. These general engineering requirements have been established to assist land developers and engineers to deal effectively with the problems of designing and building public water and sewage facilities. Capital improvement projects and land development projects sponsored by private developers and County respectively, will be designated to conform to the procedures, requirements and criteria set forth in this manual.

1.1.3.3. This manual is not intended to restrict the design professional in their opportunity to create innovative, practical and economical designs, but to expand their opportunity to advance projects efficiently and economically within the framework of design parameters established herein.

## 1.2. JURISDICTION

### 1.2.1. County

1.2.1.1. The Bureau of Water and Sewer has the responsibility for the design, construction, operation and maintenance of certain public water and sewer systems within its political boundaries.

### 1.2.2. Private

1.2.2.1. Certain privately owned community and industrial water and sewer systems are not under the jurisdiction of the County Department of Public Works (DPW). These systems are under the jurisdiction of the Maryland Department of the Environment and various other agencies. There are also certain State-owned facilities in the County with water and sewer systems that are operated and maintained by State personnel. Also, there are water and sewer facilities in the County that are operated and maintained by Washington County. For purposes of design, these guidelines consider State and Washington County as privately owned systems.

### 1.2.3. Municipalities

1.2.3.1. County Standards: Several municipalities within County own, maintain and operate their water and/or sewer systems, but have chosen to adopt all or parts of the *Standard Specifications* and *Standard Details* for use in their systems. At the request of the respective municipality, County performs design review services for the respective municipality.

1.2.3.2. Municipal Standards: In those instances where a particular municipality owns, maintains and operates its own water and/or sewer system and has adopted standards that differ from the County, it is incumbent on the design engineer to contact the respective municipality to obtain the necessary design and construction standards.

1.2.3.3. Design Review Services: The County DPW currently performs design review and construction inspection services for various municipalities as shown in the Appendix.

### 1.2.4. State and Federal

1.2.4.1. General: All construction contract documents for the extension or alteration of water and sewer systems within the State of Maryland are subject to the requirements of COMAR.

1.2.4.2. MDE Approval: After review and approval, a construction permit is issued by the Maryland Department of the Environment (MDE). This agency also acts as a control and

coordinating agency on a statewide basis in establishing priorities for construction grants and loans associated with the Safe Drinking Water Act of 1986, Clean Water Act of 1977 (Public Law 95-217), and various regulations by U. S. Environmental Protection Agency. During the construction process, MDE performs certain inspections to assure conformance with design intent. After the construction is placed into operation, MDE performs inspections and requires various laboratory tests to assure water quality regulations are being adhered to. All aspects of the County water and sewer systems that are in operation must be under the responsible charge of persons who are MDE certified operators.

1.2.4.3. Other state and federal agencies exercising control over water and sewer projects with respect to location and siting of facilities include, but are not limited to:

- U. S. Army Corps of Engineers
- Maryland Department of Natural Resources (WRA)
- Soil Conservation Service
- Federal and State Highway Administrations

### 1.3. PROJECTS DEFINED

1.3.1. Developer Projects: A typical developer project originates when a developer undertakes the subdivision of a parcel of land, as set forth in the County Subdivision Regulations. If the proposed development is in a properly classified area according to the County Water and Sewer Plan, which designated when and what public water and/or sewage facilities are to be constructed, the development may proceed if other pertinent requirements are met. The developer will be required to underwrite completely the cost of construction of any public water and sewer utilities, as set forth in the Bureau of Water and Sewer Rules and Regulations. Subsequent requirements include the preparation of some or all the following: hydrogeologic study, feasibility or site location studies, engineering report, construction plans and specifications, right-of-way documents, tap agreements or other legal documents, and the stakeout and inspection of the construction work. Normally, a developer project is represented by a signed contract between the developer and the County and is termed a Public Works Agreement (PWA).

#### 1.3.2. Typical PWA terms and conditions.

1.3.2.1. The developer is the equitable owner of certain lands in the County.

1.3.2.2. All deeds for water and sewer facilities are recorded among the Land Records of the County at the developer's expense.

1.3.2.3. The developer applies to the County for construction of the necessary permanent facilities. If it is determined that construction should be advertised, bid, awarded, and contracted by the County, it will be so at the expense of the developer.

1.3.2.4. The design of the system, advertising, bidding, etc. shall be in accordance with the latest *Standard Specifications and Details*.

1.3.2.5. The developer is responsible for all costs in connection with the review, approval, engineering, deeds, construction, inspection and any other costs incurred that are directly related to the project. As a condition for approval to begin construction, the developer must among other requirements, post financial guarantees of 110% of the estimated cost to complete the construction.

1.3.2.6. After completion of the design, and approval by the County, the County shall if deemed necessary, advertise the facility for a construction bid.

1.3.2.7. In certain instances, the County may require the developer to install systems in excess of what is required to serve the developer's project. In these cases, the County may require alternative bids to determine a fair price for reimbursement to the developer. When the County requires oversizing of mainline piping, the developer is reimbursed for the full oversizing cost of installing the larger piping.

#### 1.3.3. Capital Projects

1.3.3.1. General: Capital Project may originate by any of several administrative means, but the common identifying feature distinguishing it from a developer project is that funds for the implementation of the project are allocated by the regular budgetary processes within the County. Capital projects may involve the installation of major elements of the water or sewer system, such as: water supply and treatment, water transmission and storage, sewer outfalls, collection, interceptors, and treatment facilities.

1.3.3.2. Bids: Construction contracts for capital projects are bid in accordance with the County's purchasing procedures and requirements.

1.3.3.3. Joint County/Developer Projects: Design and/or construction contracts for joint County and Developer projects will be let or bid in accordance with County capital project requirements. The developer will provide financial guarantees equal to the determined value of the developer's portion of the contracts.

#### 1.4. SYSTEMS DESCRIPTION

##### 1.4.1. General

1.4.1.1. Public water and sewer service is restricted by the County Code to serving those properties located within the County. No new privately owned community water and/or sewer

systems are permitted in the County. Privately owned on-site systems that serve individual dwellings are under the jurisdiction of and require permits from the County Health Department.

1.4.1.2. Both the Bureau of Water and Sewer and the Department of Planning and Zoning maintain a series of maps at various scales showing the location and size of both existing and planned elements of the County's water and sewer systems.

#### 1.4.2. Water System

1.4.2.1. General: The County potable water system encompasses all features of a modern and up-to-date public water utility system including water supplies, treatment plants, a network of distribution mains, storage facilities, pumping stations and property service connections. The water utility system is designed to provide a hydraulically balanced system that accommodates fluctuations in consumer demands and provides adequate flow rates and pressures for combatting fires in combination with other system requirements. Drinking water quality (that is, absence of biological and chemical contaminants) is regulated by the Environmental Protection Agency (EPA) and the Maryland Department of the Environment (MDE). Source of water supply can be either ground water (wells) or surface water (river, lake or spring). After treating water obtained from the source, the County provides water to the customer's property line at a controlled level of quality and pressure. Fire hydrants are included with the construction of distribution system mains. Water supplied to consumers is metered to each lot or residence at the point of use. The County is developing a central monitoring system using telemetry that will continuously monitor the operational condition of the water system and will permit quick response under emergency conditions. The County assumes full responsibility for the operation and maintenance of its water system that typically extends to the customer's property line, unless otherwise arranged.

1.4.2.2. Pressure Zones: Because of the topography, the County's water systems are divided into pressure gradient zones to provide an acceptable range of operating pressures to consumers.

1.4.2.2.1. General: Pressure gradient elevations have been determined for both the existing distribution network and planned service areas. Zones are identified by the maximum pressure gradient available in terms of elevation above mean sea level. Zone boundaries are defined by the maximum and minimum ground elevations.

1.4.2.2.2. Gravity Pressure Zones:

ZONE #	TANK OVERFLOW	MAXIMUM GROUND ELEV.	MINIMUM GROUND ELEV.
1	473.00	373.00	243.00
2	610.00	510.00	373.00
3	737.00	637.00	510.00
4	870.00	770.00	637.00
5	1,001.00	901.00	770.00
6	FUTURE	FUTURE	FUTURE

1.4.2.2.3. Pumped Pressure Zones: Water pressure zones whose source of pressure is by booster pumping station or by mainline pressure reducing valves shall be designed to match pressure gradients of gravity pressure zones.

1.4.3. Sewer System

1.4.3.1. General: The County sewer system encompasses all features of a modern up-to-date public sewer utility system including property service connections, collector sewers, trunk or interceptor sewers, pumping stations, treatment plants, and treated effluent outfall sewers. The sewer system is designed to collect wastewater from the customer's property line, convey the wastewater to a treatment plant, perform treatment processes to remove contaminants, and discharge treated effluent to a designated stream or river. The quality of treated effluent and residual sludge is regulated by EPA and MDE. Except in rare instances, wastewater collected from individual customers is not metered. The County is developing a central monitoring system using telemetry that will continuously monitor the operation condition of the sewer system and will permit quick response under emergency conditions. The County assumes full responsibility for the operation and maintenance of its sewer system that typically extends to the customer's property line, unless otherwise arranged.

1.4.3.2. Sewer Service Areas: Sewer service areas are typically determined by the topographical boundaries of natural drainage basins. Typically, wastewater is collected by gravity from individual properties and flows by gravity to the lowest point in the collection system pipeline where the wastewater either undergoes treatment at a plant or is pumped to another service area. Sewer service areas usually derive their name from the respective treatment plant or the neighboring service area that receives the wastewater.



## 1.5. PROJECT INCEPTION

### 1.5.1. Developer Projects

1.5.1.1. Service Area Classification: When a land developer desires to provide public water and sewer services to their proposed development, they must first submit a request to the Director of Planning and Zoning for consideration. The Director will check the Water and Sewer Plan to evaluate whether the proposed development area is properly classified for such service. If the area is not of the proper classification, the developer can submit a request for the area to be reclassified.

1.5.1.2. Adequate Public Facilities: The existing system capacity must be adequate and the proposal must be in conformance with the Master Plan for Water and Sewer. If any of these requirements cannot be met, the developer will be so advised and will be directed to an alternative course of action. If the project meets the requirements of the *Frederick County Adequate Public Facilities Ordinance*, the existing system capacity is adequate and the Bureau of Water and Sewer will issue a letter of approval. Also the Bureau can provide the general financial requirements the developer must satisfy to continue with the project. If the project is eligible for public water and sewer services, the developer may advance the project by employing a Maryland Registered Professional Engineer for the water and sewer requirements.

1.5.1.3. Engineering Reports: The engineer will begin the project by developing a preliminary letter report addressing the considerations set forth in the following chapter. The report will be used as the basis for a PWA that includes the financial arrangements for both engineering design and construction costs. Upon the receipt and approval of the preliminary letter report the engineering design of construction drawings is authorized. The requirement for an engineering report may be waived by the Bureau of Water and Sewer depending on the size of the development.

1.5.1.4. General Procedure: For developer projects, the alignment of the water and sewer mains shall be located so that all existing and proposed lots/parcels shall front public water and sewer mains. These plans are submitted as either preliminary plans or site plans for review and comments through Planning and Zoning to DPW. The plans are then brought to completion by addressing all County agency comments. Upon approval of preliminary plans, the developer can proceed with preparation and submittal of improvement plans that provide the finished design for construction of any water and sewer system elements required. Upon receiving County comments, the resubmission shall be as aforementioned for final review and approval. Preparation, submission, and approval of appropriate deed for easements and

fee simple property transfers must be completed to satisfy approval for construction. After approval by the Department of Public Works, the project is ready to advance to the construction phase. The final action by the developer is the financial settlement between the County and developer in accordance with the terms of the PWA.

1.5.1.5. PWA: For typical subdivision water and sewer construction, the developer with the developer's contractor arrange an agreement with the County relating to how the construction will proceed and the contractor will be paid. In this context, off-site construction refers to construction of County-owned water and sewer elements on lands not owned by the developer. For typical commercial site development, on-site construction refers to construction of non-County owned water and sewer elements on land owned by the developer. Such on-site work is usually accomplished with a Modified PWA that provides for compensation for County inspection.

#### 1.5.2. Capital Projects

##### 1.5.2.1. Initiating Capital projects

1.5.2.1.1. Petition: Residents may petition the County to undertake projects or to advance projects previously contemplated. Petitions for water or sewer service are received by DPW, reviewed by the staff and endorsed with its recommendations, then forwarded to the Director of DPW.

1.5.2.1.2. DPW may originate projects through its staff planning by way of its special knowledge of requirements necessary to alleviate existing or projected problems in the overall operation of the systems.

1.5.2.1.3. The County Health Department may propose water and sewer projects that come to its attention through its responsibility in maintaining the public health and welfare.

1.5.2.1.4. County Commissioners may request the creation of a capital project to originate the process on a project that has come to their attention.

1.5.2.2. Public Hearings: As required by the County Code, prior to action by the Commissioners, public hearings are held to review the proposed budget items to display publicly all proposals for capital projects and to receive citizen comments relating thereto.

1.5.2.3. Consultant Contracts: Most of the preliminary work associated with the identification of capital projects is accomplished by DPW staff; however, after adoption and funding of capital projects is completed, it is normal for the County to engage the services of consulting engineers to provide the detailed engineering for water and sewer projects. Selection of engineers is made in accordance with County regulations and policies. Contracts with consulting engineers on water and sewer projects will stipulate the scope of work, the schedule to be followed and arrangements and other details normally associated with contractual procedures. Changes in the consultant's scope of work will be through a change order to the engineering agreement. Unless otherwise specified, the engineer for capital projects will advance a project in the same general manner as described for developer projects.

1.5.2.4. Project Management: The engineer will begin the project by preparing a concise report of the project describing the purpose and extent of the work, a preliminary cost estimate and other items of an engineering nature as specified in subsequent chapters. Review and approval routines, unless otherwise specified, will be followed for developer projects. For matter relating to water and sewer projects, the design engineer's point of contact is with DPW, Bureau of Water and Sewer. The Bureau of Water and Sewer will designate a Project Manger from its staff who will assume responsibility for monitoring the project, coordinating details, and reviewing reports, plans, specifications and other data to ensure that the engineering work satisfies the County's requirements.

## 1.6. PREPARATION OF CONSTRUCTION PLANS AND SPECIFICATIONS

1.6.1. Purpose: This section sets forth requirements for preparation of construction drawings and specifications.

1.6.1.1. In order for the County to plan and provide necessary maintenance activities, including emergency repairs, etc., it is necessary that the plans are clearly drawn, can be accurately scaled, and show all information necessary to be included as a permanent record.

1.6.1.2. Construction Documents: The primary purpose of construction plans is to show the extent, size, and location of all materials and structures to be installed as elements of a water or sewer system. The primary purpose of specifications is to define contractual relationships and conditions, material quality and workmanship quality. The drawings and specifications must be developed in sufficient detail to depict the elements and their spatial relationship with both existing conditions and planned future improvements. Besides, the definition must be complete to the extent that an inspector has adequate basis for accepting or rejecting the constructed work product.

### 1.6.2. Construction Documents

1.6.2.1. General: The primary documents used on construction projects that form the basis for a construction contract are: the construction plans, the *Standard Specifications*, *Supplementary General Conditions*, *Special Conditions*, *Special Provisions* and the *Standard Details*. Taken together, these documents represent written instructions to the contractor, who in turn, agree to provide all means necessary to construct the project as shown on the drawings and as specified.

1.6.2.2. Responsibility: The engineer's responsibility is to describe and display the work in sufficient detail so that both the County and the contractor clearly understand what work is to be accomplished and how the work is to be paid for. It is in this context that the County has become accustomed to certain practices for the development of drawings that are coordinated with specifications and the administration of construction contracts for water and sewer projects.

1.6.2.3. Field Work and Data Collection: In preparing plans for construction, the design engineer is responsible to perform updated field surveys and to acquire as-built information on existing water and sewer elements from the County Division of Construction Management and Division of Operations. When designing modifications or interfaces to existing facilities, the design engineer shall arrange a site visit to confirm the accuracy of as-built drawings. Modifications may have occurred that are not reflected in the County as-built drawings. Drawings submitted to the County for review shall reflect the most recent information available.

1.6.2.4. Presentation: Construction drawings must present information in both pictorial and text using formats, symbols, and notation as required in these guidelines. Use of computerized drafting is acceptable so long as requirements of these guidelines are followed.

### 1.6.3. Construction Specifications

1.6.3.1. General: The County has adopted *Standard Specifications and Details* for construction of water and sewer mains. The design engineer shall utilize these standards except when conditions call for provisions not included in the *Standard Specifications*.

1.6.3.2. Supplemental Specifications: In those instances where the County standards do not provide for what is required, the engineer can supplement the standards by providing notes on the drawings, modified pictorial views on the drawings, or separate specifications in a booklet.

1.6.3.3. **Standard Format:** The format in the *Standard Specifications* will be followed in the preparation of any supplemental booklets. If a section does not exist, it is suggested that the engineer follow the format established by the Construction Specification Institute (CSI), 601 Madison Street, Alexandria, Virginia 22134. At a minimum, the first page of supplemental specifications shall provide title of project, County Contract Number, date, engineering firm, and seal and signature of a Maryland Registered Professional Engineer.

1.6.3.4. **Supplementary General Conditions, Special Conditions and Special Provisions:** These sections are extremely important to the construction contract since they contain additions and modifications applicable to each project. The definitions for the aforesaid conditions and provisions are provided in the *Standard Specifications*.

1.6.3.5. **Codes and Regulations:** The construction design as delineated on the plans and specifications must reflect the most recent versions of all applicable codes and regulations, including but not limited to those associated with EPA, MDE, National Electric Code, OSHA, MOSHA, County Codes, handicap provisions, and American Disability Act. It is incumbent on the design engineer to keep abreast of any and all regulations and codes that affect water and sewer design.

1.6.3.6. **Related Standards:** In absence of specific design direction from any federal, state, and County requirements, the design standards found in the *Ten States Recommended Standards for Water and Sewer Works* as published by Health Education Services shall be consulted for water and sewer design development.

1.6.3.7. **Professional Organizations:** Design engineers are encouraged to incorporate standards and practices of recognized professional organizations such as: AWWA, WEF, ASCE, ASME, IEEE, CSI, etc.

#### 1.6.4. Submitting Plans for Approval

1.6.4.1. **Checklists:** Prior to submitting plans to the County, the design engineer shall fully complete the checklist(s) for each sewer and water project, as applicable. The checklist shall be completed and attached to each set of drawings submitted for review. This shall apply to all capital projects as well as developer projects. A checklist is provided in the Appendix of this manual.

1.6.4.2. Revisions to Approved Plans: If changes are required to the approved plans, initiated by the developer, contractor or engineer, two sets of approved prints with the changes marked-up in red shall be submitted directly to the Bureau of Water and Sewer for review. If the change is deemed minor, the Bureau will keep one copy and forward the second copy to the Division of Construction Management. If the change is deemed major, the Bureau will require new drawings to be prepared with new, blank signature blocks applied for signature by the Director.

1.6.5. Design and Drafting Standards

1.6.5.1. Plan Media and Lettering

1.6.5.1.1. Drawing Size: All water and sewer construction projects shall be prepared no smaller than 22-inch x 34-inch and no larger than 24-inch x 36-inch original drawings (linen or mylar). Borders shall be  $\frac{1}{2}$ -inch on all side with the exception of the left side that shall be 1-inch minimum. A standard title block shall be located in the lower right hand corner, when possible. The material to be used must accept both ink and pencil work and the quality and characteristics are to be equal to K&E Product #'s 170153, 170253, or 170453 Phoenix for linen, and product #191253 Herculene (3 mil thickness matted both sides) for mylar material. Other material shall be approved by the Bureau of Water and Sewer prior to use.

1.6.5.1.2. Lettering: Lettering for titles, subtitles and notes placed on the drawings shall be of sizes and styles approved by the Bureau of Water and Sewer. All drawings furnished to the County shall be printed from the first generation mylar of the Engineer's tracing. Vertical lettering shall be used throughout. Lettering shall be uniform, neat in appearance, free of stylization, and large enough to be read when reduced and microfilmed for County filing. Lettering for title blocks, subtitles, signature blocks, sheet numbering, scales, etc. shall be oriented left to right along the bottom 36-inch edge of the sheet.

1.6.5.2. Plan Cover Sheet

1.6.5.2.1. Vicinity and Locations Maps: The first sheet of all projects shall include a 1 inch = 600 feet scale vicinity map with three unique sets of grid coordinates arranged to form an "L", and sufficient road names and other features to allow easy

recognition of the site. If the vicinity map cannot clearly show the location of the project site relative to at least two main roads, then a project location map shall be prepared at a scale of 1 inch = 2000 feet. The location map will be in addition to the vicinity map.

1.6.5.2.2. Position of Vicinity and Locations Maps: If a set of contract drawings contains only one or two drawings, the vicinity map shall be placed at the upper right portion of the first drawing in a space measuring 6 inches vertically and 6 inches horizontally. If the vicinity map cannot fit in the said space or whenever there are three (3) or more drawings to the contract, then the first sheet shall be designated as a title drawing with the vicinity plan centered on the drawing.

1.6.5.2.3. Other: The vicinity map shall show a north arrow, proposed project boundaries, contract number or proposed work, and boundaries of adjacent existing and future contracts.

1.6.5.2.4. Information: Provide, under or near the vicinity map, an informational block containing the following: water pressure zone, number of lots, number of estimated equivalent dwelling units (EDU), use of buildings/structures, and sewer service areas. In addition to the vicinity and/or location maps, the drawing shall show the contract title, contract number, engineer's name, address and telephone number, and developer's name, address and telephone number.

1.6.5.2.5. General Notes: The first sheet of a set shall show the General Notes pertaining to the contract. See appendix for the text of these notes. If the General Notes cannot be placed on the initial drawing, a note shall be included on that sheet indicating on which sheet the General Notes appear. When applicable the engineer shall provide additional general notes indicating pipe materials, special meter requirements, abandoning requirements, etc.

1.6.5.2.6. For convenience in filing, a note shall be placed immediately above the title block on the right side of each cover sheet indicating the title of the project and its contract number.

1.6.5.2.7. Sheet Index Schedule: On projects with three (3) or more sheets total, a sheet index schedule also shall be shown on the title sheet indicating the purpose of each sheet.

1.6.5.2.8. Index Map: On projects with four (4) or more plan view sheets, an index map showing the plan coverage of each sheet shall be shown together with the corresponding drawing number for ready reference. Scales of index maps are typically 1 inch = 200 feet. At a minimum, sheet index maps shall show street names, proposed mains, valves, manholes, and all rights of way and easements.

1.6.5.2.9. As-built Tabulations: If space permits the first sheet also shall include a tabulation of materials with columns for: bid quantity, as-built quantity, and material/supplier. A standard "quantities box" is supplied in the appendix. This shall be filled out anytime prior to submission of the mylars for signatures by the Department of Public Works.

1.6.5.2.10. Revision Block: A revision block shall be provided to docum.2.10. Revision Block: A revision be provided to document all changes made to the drawing(s). The block shall furnish the revision number, date of the revision, description of the changes and the initials of the initiator of the changes.

1.6.5.3. All Plan Sheets

1.6.5.3.1. PE Seal: Each sheet shall bear the official stamp and the original signature of the professional engineer registered in Maryland who assume responsibility for the work.

1.6.5.3.2. Signature Blocks: Signature blocks for the Director of Public Works and Chief Engineer shall be located in the lower right hand corner or as close as possible. Formats for various signature blocks are included in the Appendix.

1.6.5.3.3. Scales: Each sheet shall indicate the horizontal and vertical scales. Typically horizontal scales are 1 inch = 50 feet and vertical scales are 1 inch = 5 feet. Some commercial, industrial and townhouse site plans use 1 inch = 30 feet. Generally, all pictorial views for construction purpose shall be drawn to scale. Views "not-to-scale" are permitted to present schematic or diagrammatic information where spatial relationship is not essential.

1.6.5.3.4. Other: Each sheet in the complete set of drawings shall provide a contract title. Starting with the first sheet, each shall be numbered successively. When drawings cover more than one section, phase or contract, an index sheet shall be provided showing each existing, proposed and future sections, phases or contracts.



## 1.6.6. Design Considerations and Presentation

### 1.6.6.1. Existing, Proposed, and Future Conditions

1.6.6.1.1. "Proposed" indicates those utilities, easements, buildings, roads, etc. that are intended to be constructed as defined by the plans in hand. Abbreviated as PROP on the drawings.

1.6.6.1.2. "Existing" indicates those utilities, easements, buildings, roads, etc. that have been constructed and exist (or are considered to exist) at the time the plans are submitted for review. Abbreviated as EX on the drawings.

1.6.6.1.3. "Future" indicates those utilities, easements, buildings, roads, etc. that are either planned for construction subsequent to the proposed work or under concurrent design by others. Abbreviated as FUT on the drawings.

1.6.6.2. Linework: Proposed conditions of work are to be drawn with bold lines. Lightened, dashed lines are used for existing and future conditions.

1.6.6.3. Field Survey: In order to develop the required information to scale, the engineer maybe required to conduct field surveys to establish accurately horizontal and vertical control points along the route or on the site area of the project if as-builts are not available or sufficient monumentation exists within 2,000 feet of the property. The County's horizontal coordinate system is based on the Maryland State Coordinatate System, Grid North. A standard for vertical control is under consideration at DFW.

1.6.6.4. Limits of Area to be Shown: The limits of the area to be shown on the drawings may vary to some degree on various types of projects, but in general for capital projects the area covered is usually a continuous strip of a miniminum of 100 feet each side of the proposed facility, 200 feet beyond the end of proposed pavement for future roadways. For developer projects, limits of area shown shall include as a minimum all features within a 100 feet radius from any proposed construction.

### 1.6.6.5. Utilities, structures and other features.

1.6.6.5.1. All utilities, structures, topography, landscape and cultural features must be clearly and completely depicted. A tabulation of drafting symbols is given in the *Standard Details*. As a minimum, features to be depicted include:

1.6.6.5.2. Size, horizontal and vertical location of all existing, proposed, and future surface and sub-surface utilities including: water, sewer, gas, electric, cable TV, together with their respective rights-of-way and easements. Provide typical width dimensions of standard easements and right-of-ways. This information is developed from field surveys, other proposed plans, as-built plans and information provided by the owner of the respective utility.

1.6.6.5.3. Test Pitting: In certain instances the designer on behalf of the owner may be required to determine (in advance of construction plan approval) locations of existing utilities or underground structures by means of digging test pits.

1.6.6.5.4. Contract Numbers: Identify and reference County contract numbers of all existing, proposed and future facilities within and adjacent to the project limits.

1.6.6.5.5. Identify all buildings and other structures within, and immediately adjacent to the project limits, with all improvements, including wells, septic tanks, drainfields, etc.

1.6.6.5.6. Identify roadway pavements, curb lines, driveway entrances, walkways, fences, walls, etc., including types of materials, widths, heights, and all other descriptive data.

1.6.6.6. Property and Site Information: In new developments where the terrain is being transformed, most of the information shall be obtained directly from approved preliminary or site plans prepared to satisfy planning or subdivision requirements. In this case, the water and sewer plans shall show all proposed improvements including curbs, storm drains, street rights-of-way and lots as taken from the record plat. Also, construction drawings shall show all existing features that are to remain undisturbed. Property information to be shown is as follows:

Owner name(s) of adjacent properties.

Deed and recording references, including parcel number, lot number, subdivision name and record plat references(s).

Property survey pipes, monuments or markers, if any.

Street address, if available.

1.6.6.7. **Peripheral Easements:** To provide for future development, easements to provide water and sewer service to properties adjoining those served by the proposed contract must be established on the development property. This avoids inadvertant creation of island parcels that become excluded from water and sewer access.

1.6.6.8. **On-Site Water and Sewer:** For certain industrial and commercial applications, the water and sewer mains on private property may be privately owned and maintained; nonetheless, the construction is inspected by Department of Public Works and thus the plan and profile views are required to meet Department of Public Works design and construction requirements. The interface between the County and the private mains must be clearly indicated on the plans. Also, it is advisable to provide the name, address and telephone number of the private owner.

1.6.6.9. **Non-Dedicated Street Water and Sewer:** For certain townhouse and apartment developments, the water and sewer system is to be owned and operated by Department of Public Works, but the system is to be installed in streets that are to remain privately owned. Department of Public Works will have authorized access to maintain the system through appropriate deeded easements that will be clearly indicated in the plans.

1.6.6.10. **Other Municipal Water and Sewer:** When the water and sewer is to be owned and operated by a municipality or in some way involves another municipality, the nature of the relationship shall be noted on the plans. The municipality shall be identified including a contact person. The applicable design and construction standards shall be identified.

1.6.6.11. **Trees:** The provisions of the *Forest Resource Ordinance* (FRO) shall be complied with. In instances where the clearing of trees within a right-of-way is necessary and in order to comply with the FRO, trees may be replanted at other Bureau of Water and Sewer facilities. The Engineer shall consult with the Bureau before initateing any design.

1.6.6.12. **Water Courses:** Water courses such as streams, swales, ditch areas, shall be shown and located including width, depth and water depth, drainage area at the utility crossing, if applicable. Water courses shall be contoured from field data together with the 100-year flood plain and elevation shown on the drawings. Contours shall be shown on both sides of the water course and extended at least 100 feet beyond the parallel alignment of the proposed facility. The flood plain data shall be based on the County's floodplain section of the *Zoning Ordinance*. In planning the design, consider the impacts of water courses and the expense of construction and maintenance accessibility after the construction is placed into service. Moreover, the construction may be delayed considerably because of the time required to obtain necessary waterway construction and various wetland permits.

1.6.6.13. Encroachments: Encroachments of water and sewer in easements and rights of way not under the jurisdiction of the County shall be avoided unless compelling reasons are presented. Encroachments of utilities not under the jurisdiction of the County shall be avoided wherever possible, for example, privately maintained storm drains. Structures and structures such as footers are considered as encroachments when situated in water and sewer easements. Make requests for permission to encroach in a water and sewer easement to the Bureau of Water and Sewer. Routing a water and sewer pipeline through non-County right-of-ways such as State highways and railroads may require substantial time for negotiating agreements and obtaining permits.

1.6.6.14. Restoration: In developed areas, a restoration table shall be provided. The table shall cover the entire limits of the project. Restoration items shall include, but not be limited to: roadways, grassed areas, driveways, fences, etc. The table shall clearly specify the location and material to be restored.

1.6.6.15. Miscellaneous

1.6.6.15.1. Existing and proposed embankments and other irregularities of terrain including roadside drainage ditches shall be shown and spot elevations of top and bottom of bank shall be provided to prove adequately positive drainage.

1.6.6.15.2. Vehicular access routes for off-road or undeveloped areas shall be identified for use during construction.

1.6.7. Plan and Profile Views

1.6.7.1. General

1.6.7.1.1. Labeling: Mainline pipe sizes are indicated in plan and profile view as 8" W, 12" W, 8" S, 16" S, etc. Service connection pipe size shall be indicated in the general notes. Existing is abbreviated as EX, proposed as PROP and future as FUT.

1.6.7.1.2. Right-of-ways: Right-of-ways, street pavements, and easements shall be shown in both plan and profile. Width dimensions of each straight run segment shall be shown in plan view. Maryland state roads shall be identified by route number and SHA plat number, if available.

1.6.7.1.3. Location: Almost always, plan view shall be accompanied by a corresponding profile view. Features labeled in the plan view require corresponding labeling in the profile view. For mainline layout, the profile view shall be located directly below the plan view. For some townhouse

developments, the profile view can be shown on a separate sheet if the view is cross referenced to the plans.

1.6.7.1.4. Profile Axis: Both sides of a profile view must show a vertical axis with major ticks at 5-foot elevation intervals. Each major tick must be labeled with appropriate elevation. Horizontal scale shall not be less than 1-inch = 50 feet.

1.6.7.1.5. Orientation and Titles: All plan and profile views shall be appropriately titled and be oriented the same from right to left. Typically, a title includes street name, and whether the project is water or sewer. Occasionally, profile views require the compass direction indicated.

1.6.7.1.6. North: Every plan sheet or view shall have the true north direction indicated.

1.6.7.1.7. Water and sewer service connections, shall be shown to the property (or easement) line in plan views.

1.6.7.1.8. Combining Profiles: When water and sewer mains are separated by a horizontal distance of 10 feet or less, the profile of each main can be combined in one view. If the finished ground elevation is less than one foot over each utility, then separate profiles are required.

1.6.7.1.9. Limits of Work: Contractor's work limits and access road shall be clearly indicated.

1.6.7.1.10. Benchmarks: At least one elevation bench mark shall be provided in the plans with adequate benchmark recovery diagrams.

1.6.7.1.11. Grid Ticks: At least three State grid ticks shall be shown on every plan sheet.

1.6.7.1.12. Pipe Material: Type of pipe material shall be indicated in the profile view or general notes, for example, DIP for water mains and PVC for sewer mains.

1.6.7.1.13. Detail Numbers: When the *Standard Details* are used, the number shall be indicated in both plan and profile view or in a general note. This practice is helpful to contractors unfamiliar with Department of Public Works standards and reduces the number of problems encountered in the field.

1.6.7.1.14. Match Lines: Where continuity of views is interrupted, indicate the appropriate sheet number or location where the view continues. When there are multiple contracts associated with one development project, each contract shall be drawn to the same orientation from right to left in such a way that no sheets need to be inverted or rotated to match with sheets on adjacent contracts.

1.6.7.1.15. Borings: If special subsurface or boring information is available, it shall be indicated. Also, any structural fill requirements shall be indicated.

1.6.7.1.16. Floodplain: Show 100-year flood delineation.

#### 1.6.7.2. Stationing

1.6.7.2.1. General: Water and sewer mains can be stationed from a vertical plane through either the centerline of the piping or the centerline of the road in which the piping is to be installed.

1.6.7.2.2. Non Dedicated Street: Where the main is not located in a dedicated street, the horizontal dimension on the profile will reflect the horizontal distances along the centerline of the main as viewed in the plan. The stations on the water profile shall be the actual stations measured horizontally along the water main and the stations on the sewer profile shall be the actual horizontal stations between manholes.

1.6.7.2.3. Dedicated Street: When mains are located in the road right-of-way, the road centerline grade and stationing may be used to develop the profile view. Stations along the street centerline are established in plan and these stations are transferred to true scale to the profile. As viewed in the profile, the locations of water and sewer main features represent the projected location along the road centerline. This means that horizontal distances pertinent to the mains cannot be accurately scaled on a profile view when either the road centerline curves or when the road and main deviate from parallel alignment in plan view.

1.6.7.3. Ground Line Delineations: When the profile stationing is referenced from the road centerline, the ground line on the profile sheet shall represent the elevations along the centerline of the road. Where the proposed street grade differs from the existing grade by one foot or more, the existing grade will be indicated by a dash line and the proposed centerline grade by a

solid line. When the water or sewer line is not located within a dedicated street, the ground lines on the profile shall represent existing and proposed elevations along the centerline of the water or sewer main. The date of the survey or other reference used to establish existing ground lines shall be noted on the plans.

#### 1.6.8. Water Mains

##### 1.6.8.1. Plan View

1.6.8.1.1. Scale: Plans shall be drawn at a scale of 1 inch = 50 feet, or larger, that is, 1 inch = 30 feet.

1.6.8.1.2. Preliminary Plan Compliance: Plan layout of water main shall comply with preliminary plan, except for minor changes of alignment. All lots within 200 feet of the main shall have access to the main.

1.6.8.1.3. Location: All County owned water mains, appurtenances, and service piping shall be located in a public right-of-way in County water and sewer owned property, or in an appropriate easement.

1.6.8.1.4. Representation: Pipe lines 24 inches in diameter and smaller, shall be shown symbolically at two (2) feet wide at the scale designated. Pipe lines with diameters greater than 24 inches shall be depicted to scale.

1.6.8.1.5. Appurtenance Symbols: Fittings, valves, hydrants and other appurtenances shall be shown by symbols and identified by size and type, for example, 6" T, 8" V, in both plan and profile view.

1.6.8.1.6. Water Service Connections (WSC): WSC shall be shown as a pipe from the main to a meter at the property lines. The WSC size must be labeled, for example 1", in the general notes or as typical, in the plan view.

1.6.8.1.7. Meter Vaults: For large commercial meters, show meter size, vault footprint, and bypass piping. Indicate vault standard detail number.

1.6.8.1.8. Joint Restraint: When joint restraints are required, for example, Megalugs<sup>R</sup>, indicate where to be used.

1.6.8.1.9. Crossings: For road, stream, irregular terrain, etc., excavations and crossings, show method of construction in both plan and profile view. Sometimes a larger scale is required. Also, show any special construction needed to protect water main when in close proximity to sewer or other pipes, etc.

1.6.8.1.10. Alignment: Horizontal and vertical alignment must be configured to follow changes in street alignment and to pass obstructions with adequate clearance for maintenance and construction. Alignment changes are accomplished by bends and joint deflection. When pipe is deflected, the equivalent pipe radius shall be shown for each curved segment of pipe.

#### 1.6.8.2. Profile View

1.6.8.2.1. Scale: Profiles shall be at the same horizontal scale as the plan, typically a scale of 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical. Main pipe, air release structures, etc. shall be shown to profile scale, with no exceptions.

1.6.8.2.2. Grades: Show existing, proposed and future grades.

1.6.8.2.3. Dimensioning: Profile dimensioning shall refer to main pipe invert, although reference to top or bottom of pipe may be used if clearly indicated.

1.6.8.2.4. Stationing: Develop stationing preferably from centerline of pipe. Next best is to develop from the centerline of the road or right-of-way. Plan view stationing and corresponding inverts shall be provided at 100-foot intervals, fittings and appurtenances. Valves immediately adjacent to tees and WSC locations do not require stationing.

1.6.8.2.5. Labelling: Indicate lot number and location for each WSC. Show valves, fittings, etc., by a symbol on the main line.

1.6.8.2.6. Crossings: For any crossings of water mains and sewer or other utilities, indicate a minimum clearance dimension, typically 1 foot.

#### 1.6.9. Sewer Mains

##### 1.6.9.1. Plan View

1.6.9.1.1. Scale: Plans shall be drawn at a scale of 1 inch = 50 feet, or larger, that is, 1 inch = 30.



1.6.9.1.2. Preliminary Plan Compliance: Plan layout of sewer main shall comply with preliminary plan, except for minor changes of alignment. All lots within 200 feet of the main shall have access to the main. Major revisions shall not be permitted without County approval.

1.6.9.1.3. Location: All County owned sewer mains, appurtenance and service piping shall be located in a public right-of-way in County property, or in an appropriate easement.

1.6.9.1.4. Representation: Pipe lines 24 inches in diameter and smaller, shall be shown symbolically as two (2) feet wide at the scale designated. Pipe lines with diameters greater than 24 inches shall be depicted to scale.

1.6.9.1.5. Manhole Numbering: Manholes shall be numbered in consecutive order starting with the lowest invert elevation and proceeding uphill.

1.6.9.1.6. Flow Direction: Indicate flow direction with arrow head on pipe.

1.6.9.1.7. Appurtenance Symbols: Fittings and appurtenances shall be shown by symbols and identified by size and type, for example, 8" STUB, in both plan and profile view.

1.6.9.1.8. Sewer Service Connections (SSC): SSC will be indicated by a single heavy line from the main (preferably in a perpendicular direction from the main) to a cleanout at the property line.

1.6.9.1.9. Cleanout Inverts: The plan may indicate minimum service elevation or cleanout invert for each lot. This shall represent the lowest floor elevation that may be serviced by a gravity sewer main.

1.6.9.1.10. Commercial: Commercial or industrial lots may, if desired, have a minimum service elevation specified that allows gravity flow from the most distant part of the said lot. If a slope of less than 2% is proposed, the proposed size and slope of the main also shall be provided.

1.6.9.1.11. Crossings: For road, stream, irregular terrain, etc., excavations and crossings show method of construction in both plan and profile view. Sometimes a larger scale is required. Also, show any special constructions needed to protect sewer main when in close proximity to storm drains, other pipes, etc.

1.6.9.1.12. Alignment: Horizontal and vertical alignment must be configured to follow changes in street alignment and to pass obstructions with adequate clearance for maintenance and construction. Alignment changes are accomplished by raising or lowering the pipe or providing manholes.

1.6.9.2. Profile View

1.6.9.2.1. Scale: Profiles shall be at the same horizontal scale as the plan, typically a scale of 1 inch = 50 feet horizontal and 1 inch = 5 feet vertical. Main pipe, manholes, structures, etc. shall be shown to profile scale, with no exceptions.

1.6.9.2.2. Grades: Show existing, proposed and future grades.

1.6.9.2.3. Slope: Indicate slope of main in percent.

1.6.9.2.4. Stationing: Develop stationing, preferably from centerline of pipe. Next best is to develop from the centerline of the road or right-of-way. Begin stationing, that is, 0+00, at each manhole axis and proceed upgrade to next manhole axis.

1.6.9.2.5. Labelling: Indicate lot number and show location and station for each SSC.

1.6.9.2.6. Cleanout Invert: Each cleanout invert in plan view shall be labeled with its corresponding station. Such SSC data may be provided in tabular form for townhouse or apartment areas to minimize drawing congestion.

1.6.9.2.7. Service Drop Connections: Determine when service drop connections are required and label them as "SSDC".

1.6.9.2.8. Manhole Inverts: Indicate invert elevations and whether in or out at all connections to manholes. When more than two mainline connections, indicate compass directions of each main relative to the vertical axis of the manhole.

1.6.9.2.9. Drop Connections: Determine when drop manhole connections with mainline are required, show same with symbol and label as Type E or F. The use of inside type drop connections are to be encouraged.

1.6.9.2.10. Manhole Numbers: Indicate manhole number and rim elevation. Also provide a watertight cover, that is, "WT", if manhole rim is below the 100-year flood level, a drainage swale or other area susceptible to flooding manholes.

1.6.9.2.11. Crossings: For any crossings of sewer mains and sewer or other utilities, indicate a minimum clearance dimension, typically 1 foot.

1.6.9.2.12. Stream Elevations: Provide the elevation of a stream or swale bottom that parallels within 50 feet of a proposed sewer.

#### 1.6.10. Facilities and Related Structures

1.6.10.1. General: When using water and sewer utility terminology, the term "facility" as used in these guidelines refers to non-mainline piping elements such as treatment plants, pumping stations, storage tanks, interceptor flow meters, rechlorination stations, pressure reducing valves, control buildings, etc. A facility typically has some form of electrical equipment and/or automatically operated mechanical components.

1.6.10.2. Schematics and Sketches: Drawings and specifications for facilities typically involve unique and non-recurring design features that require considerably more individualized drafting effort and specification research than the typical pipeline design. Also, facility design involves coordination of a variety of technical disciplines. In most instances, the design engineer can economize on drafting effort by first preparing sketch plans and schematic diagrams for planning and preliminary design submittals. Preparation of formal construction drawings can begin after conceptual decisions associated with the sketch plans are approved.

1.6.10.3. Scale: Except for schematic diagrams and reproductions of package components, drawings shall be made to true scale. It is incumbent on the designer to verify the size, dimensions, and interface requirements of all components or features employed in the design.

1.6.10.4. Requirements: Although detailed design, drawing and specification requirements may be presented in the individual chapters dealing with facilities, all requirements found in Chapter 1 herein are applicable as a minimum.

1.6.10.5. Standardization: The designer shall consult the Bureau of Water and Sewer to determine, which components, process schemes, etc. have proven performance and support histories.

1.6.10.6. Site Ownership: In most cases, the facility site including any driveway access will be owned by the County. For developer projects, the property boundaries are delineated and labeled "Fee Simple Dedication to County Board of County Commissioners."

1.6.10.7. Design Considerations

1.6.10.7.1. Safety: Avoidance of hazardous conditions, provide railings, ingress and egress, and required safety equipment. Meet OSHA, MOSHA, and County safety requirements.

1.6.10.7.2. Miscellaneous includes: Acceptance procedures for equipment and processes; Painting and Coating Plan; Water for testing; Laboratory Facilities; Office Area; Chemical Storage and Handling; Operation and Maintenance Manuals; Start-Up and Equipment Checkout; Training County Operators; and Site Restoration.

1.6.10.8. Types of Drawings and Specifications Required.

1.6.10.8.1. General: Design of facilities requires the following information and types of drawings to meet minimum design requirements.

1.6.10.8.2. Site Plan: On second drawing sheet, show location of major facility units, components, and utilities such as electrical service, buildings, vaults, lighting, tanks, water and sewer pipes, yard piping, conduit runs, valves, generators, paving, fencing, etc. Provide grading plan, landscaping plan and benchmark. Show fee simple property outline and any pertinent easements. Scale for site plans shall be no smaller than 1 inch = 20 feet.

1.6.10.8.3. Mechanical: Plan, profile and sectional views of piping and equipment installation. Layout, that is, physical location of equipment. Installation of equipment, means of support. HVAC, sleeves and seals wall and floor penetrations. Show dimensional relationships. Considerations to minimize vibrations and noise from rotating machinery and air movement. Space for maintenance access. Potable water and drain piping runs. Space heating. Floor drains. Backflow preventers.

1.6.10.8.4. Electrical: Schematic diagrams include one line power schematics, control schematics and instrumentation schematics. Control logic diagrams. When manufactured package components are required, show interconnection with other components. Wire types and sizes, electrical power service installation

and meter, type of voltage and phasing. Conduit materials, sizes and routing of runs. Circuit breaker directories. On-site generator location and installation. Type, size and mounting details of panel boxes. On-site alarms and controls. Telemetry of data and alarms to the Operations Center, requires equipment installation. Running time meter, ammeters, etc.

#### 1.6.10.8.5. Architectural

1.6.10.8.5.1. Scale: Floor plans, details, etc. shall be drawn at a scale of 3/8 inch = 1 foot, unless otherwise approved by the County.

1.6.10.8.5.2. Details: Details shall be carefully coordinated with other work efforts to show all information required for fabrication, construction and installation of the items detailed.

1.6.10.8.5.3. Handicap Requirements: Handicap accessibility shall be addressed on a case-by-case-basis. In general, all permanent facilities with administrative areas must have full handicap accessibility and be barrier free. American Disabilities Act, requirements must be met.

1.6.10.8.6. Structural: Details of cast-in-place concrete pads, floors and walls. Implementation of results of soils tests and reports. Special excavation and backfilling requirements.

1.6.10.8.7. Sediment and Erosion Control Plan: A separate sediment and erosion control plan is not required, if the work proposed is within the area of disturbance for the development. Otherwise, separate plans are required for SCS approval.

1.6.10.8.8. Hydraulic: Show number of EDUs, flowrate capacities, peaking factors, critical pressure parameters, etc.

1.6.10.8.9. Process: Schematic diagram of biological and chemical processes. Provide plan view and profile view of process. Odor control provision as necessary. Chemical handling and disposal provisions.

1.6.10.8.10. Access: Design shall consider and provide for vehicular access, parking and turn-around space during all weather and seasonal conditions. Types of vehicles to be considered include: pickup trucks, passenger cars, sewer vacuum cleaning trucks, mobile cranes, backhoes, etc. Also consider type of driveway entrance and associated design criteria.

## 1.7. PERMITS AND APPROVALS

### 1.7.1. State and Federal

1.7.1.1. The Maryland Department of the Environment must approve almost all plans and issue water and sewer construction permits. Moreover, design review fees must be paid before MDE will begin their review.

1.7.1.2. Plans must be submitted and approvals obtained from other state and federal agencies. Permits from the following agencies are typical for most water and sewer designs:

- Department of Natural Resources, Water Resources Administration
- Army Corps of Engineers
- Maryland Historic Trust
- State Highway Administration (right-of-way and driveway entrance)
- Other agencies

1.7.2. Soil Conservation: Approval and signatures must be obtained by the design engineer from the Frederick and Catoclin Soil Conservation Districts and U. S. Soil Conservation Service.

1.7.3. County: For all above ground structures, the owner or their agent shall make all applications to obtain the required building and grading permits prior to bid of the project. Any footer construction, plumbing work or electrical work requires permits from the County. Make application to the County Permits and Inspections. Other County agencies requiring various approvals include the (County) State Fire and Planning and Zoning.

### 1.7.4. Other

1.7.4.1. Utility companies: Utility companies, such as: telephone, electric, television, cable, natural gas, etc., must issue all permits when their jurisdictions are encountered.

1.7.4.2. Railroads: Any railroad crossing or parallelism is subject to a permit and/or licensing agreement from the affected railroad. Many times "riders" are attached to railroad permits, typically telecommunication companies that jointly occupy railroad right-of-ways. In those cases, separate side permits are required, in addition to the railroad permit. Permitting can be tedious, requiring considerable time for approval.

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## CHAPTER 2. -- WATER MAIN DESIGN

### 2.1. GENERAL

2.1.1. Availability of Water: Designers shall check with Bureau of Water and Sewer to determine the availability of water service to the site of proposed subdivision or connection.

#### 2.1.2. Definitions

2.1.2.1. Raw Water Mains: Water mains that convey raw or untreated water from a supply source such as a well to a water treatment plant. For purposes of designing the location of raw water mains, they are considered to be contaminated and thus must be located sufficiently distant from mains containing potable or finished water, that is, raw mains are considered to be sewer force mains or storm drains as relates to the proximity to potable water mains. Design and construction of raw water mains are regulated by DPW.

2.1.2.2. Transmission Mains: Major supply mains conveying water from treatment plant to distribution mains. Design and construction of distribution mains are regulated by DPW.

2.1.2.3. Distribution Mains: Water Mains constructed to provide distribution of water from major transmission mains to service mains. Design and construction of distribution mains are regulated by DPW.

2.1.2.4. WSC: Represents the piping that originates at the distribution main and terminates at the outlet of the customer's meter. Almost always the meter is located on the customer's side of property line about 1 foot from the property (or easement) line. In some commercial applications, the meter may be located inside the customer's building.

2.1.2.5. Ownership: The WSC is owned and maintained by the County. Each WSC will correspond to a particular water service customer account. On drawings, the water service connection is labelled by the abbreviation, "WSC", and typically inserted in the general notes.

2.1.2.6. Water Distribution Pipe: Represents the piping configuration that connects from the terminus of the County's WSC (that is, meter vault) and is terminated five (5) feet from the customer's building. The water distribution pipe is owned and maintained by the property owner. Design of water distribution piping is regulated by the County Plumbing Code and the construction is inspected by the Division of Construction Management.



### 2.1.3. Responsibility

2.1.3.1. County Water System: After completion of construction, the water system is maintained by the County. Elements of the water system owned and maintained by the County include well supplies, raw water mains, treatment plants, storage tanks, pumping stations, transmission mains, distribution mains, mainline valves, fire hydrants, WSCs, water meters, water meter yokes, and water meter vaults. The water system elements owned by the County are always located on County owned property, in public rights-of-way or in water easements on privately owned property. Water related elements which are situated within private property (and not in a water easement) are constructed and maintained by the property owner.

2.1.3.2. Private Water Systems: Some large commercial sites operate water distribution systems to serve their sites that include water mains, valves, hydrants, etc. that are owned by the site owner. It is important to show clearly the limits of the private system and note this on the plans. In all cases, the private water systems are designed and constructed according to the Maryland Department of the Environment (MDE) requirements.

2.1.4. Tributary Population: Water systems that provide for a complete watershed shall be designed and sized, taking the following into consideration:

2.1.4.1. The estimated future tributary population that follows the County Master Water and Sewer Plan and the applicable regional comprehensive plan.

2.1.4.2. The entire watershed shall be assumed to be completely developed according to present zoning or to the comprehensive plan densities.

2.1.4.3. Water systems that initially provide service for only part of a watershed shall be sized and built to provide for the entire watershed. Otherwise, provisions shall be made for future increased capacity.

2.1.4.4. Supporting data shall be shown in the predesign report or on the plans.

### 2.1.5. Flow Projection

#### 2.1.5.1. Quantity of Flow

2.1.5.1.1. Population Equivalent: In sanitary engineering practice, it is generally accepted that each person will consume 100 gallons of water per day. From a hydraulic loading standpoint, 100 gpd represents one person, called "one population equivalent." This equivalent population flow, 100 gpd, has been regarded as the upper limit for domestic flow projection as a daily average.

2.1.5.1.2. Equivalent Dwelling Unit (EDU): For design planning, the County uses the population equivalent for residential areas of 2.5 persons per dwelling, or 250 gpd per dwelling. In doing flow projection calculations the term EDU is used and is equal to 250 gpd per dwelling.

2.1.5.1.3. Seasonal Peaking Factor: Because of increased water demand during the summer months, the County has determined that the average daily water flow is 1.4 times the average daily sewer flow. This factor is important when projecting flowrates for water treatment plants and storage tanks.

2.1.5.1.4. Flow projections shall be based upon the guidelines shown in the Appendix.

2.1.5.2. Average Daily Flow: Average daily flow is the arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flows from the service area. The average daily commercial, industrial and other flows shall be based on the period in which these flows are generated. The arithmetic sum of the average daily flow components (gallons per day) shall then be divided by 250 to obtain the total EDU basis for the design. Note: For purposes of the calculating flows here, the term flow is equivalent to flowrate, that is, volume of water per unit time.

2.1.5.3. Peaking of Flows

2.1.5.3.1. Peak domestic flow is average daily domestic flow (ADF) peaked in accordance with the peak hourly flow (PHF) that has been determined to be 4.0 times the ADF in the County.

2.1.5.3.2. Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with the MDE curve in the Appendix. While pertinent data is available the commercial or industrial flow can utilize a peaking factor higher than the MDE curve.

2.1.5.4. Fire Flows: Fire flow is the flow for fighting fires as required by the Rules and Regulations, Fire Marshall, or the ISO. Minimum fire hydrant design flows are set forth in the Appendix.

2.1.5.5. Design Hydraulic Flows: Design Domestic Flow = Peak Domestic Flow + Peak Commercial Flow + Peak Industrial Flow. This provides the maximum flowrate when fire flows are not included.

2.1.5.6. Design Peak Flow: Design Peak Flow = Design Domestic Flow + Fire Flow. Whenever pumped flow enters a water main or storage tank, the domestic pumping rate shall be equal to or exceed the design domestic flow and the fire pumping rate shall be equal to or exceed the design peak flow.

2.1.5.7. Hydraulic Calculations: When water main diameter must be determined by hydraulic calculations, the pressures in the mains must remain within required ranges for design peak flows.

## 2.1.6. Storage

2.1.6.1. Minimum fire flow and total storage requirements are set forth in the Appendix.

## 2.2. DESIGN

### 2.2.1. Location

2.2.1.1. General: Water mains must be routed in a public right of way whenever possible. Water mains are generally located at least 7 feet from a private property line or easement when line is parallel to the property line.

#### 2.2.1.2. Right-of-Ways

2.2.1.2.1. New Subdivisions with Pavement, Curb and Gutter: Water mains shall, where practical, generally be placed 7 feet from the center line of the street right-of-way (on opposite side of street from the sanitary sewer).

2.2.1.2.2. New Subdivisions with Pavement and No Curb: Water mains shall, where practical, generally be placed 5 feet from the center line of the street right-of-way (on opposite side of street from sanitary sewer).

2.2.1.2.3. Existing Developments with Pavement and Curbs: In existing developments with curbs, water mains shall be located, after full consideration is given to all existing and proposed facilities, within the dedicated right-of-way.

2.2.1.2.4. Existing Development with Pavement and No Curbs: In existing developments without curbs, water mains shall, where practical, generally be located outside of the edge of pavement on the opposite side of the street from the sewer, except that the main shall not be laid under a future curb or within a ditch line. The location of other existing and proposed facilities within the right-of-way shall be fully considered.

2.2.1.2.5. Along Existing State and County Roads: Water main locations shall be such that the edge of trench is no closer than 2.5 feet from the edge of the roadway, where practical.

2.2.1.3. Easements

2.2.1.3.1. General: When it is necessary to route or locate water mains in a non-public right of way or non-Bureau of Water and Sewer-owned land area, then the engineer shall proceed to establish water and sewer easements to be deeded to the County. The statutory 6-foot easement at the periphery of building lots is generally considered to be reserved for non-water and sewer utilities.

2.2.1.3.2. Through Public and Private Properties: Where the routing of a water main intrudes into or through public and/or private properties, the design engineer shall give a thorough analysis of its impact upon all existing and/or proposed physical features of the site. In all cases, the design engineer must identify and have the owner initiate the necessary Deed of Easement(s) to the County.

2.2.1.3.3. Size: Standard width for water easements is 30 feet. Even if there is only one pipeline, such as a 4-inch raw water, 30-foot width is required. If one water pipe is involved, position the pipe with a 10/20-foot offset than at the 15/15-foot centerline of the easement. The offset permits a second vehicle to pass around a backhoe that is centered over the pipeline. When two pipelines are in the easement, they shall be positioned at 10/10/10. On terminal water mains, easement shall extend at least 15 feet beyond the cap or blow off.

2.2.1.3.4. Configuration: Easements for water mains shall be configured from straight line segments and be of uniform width, that is, 30 feet. Avoid routing easements through the central interior area of building lots. Whenever possible, keep easement centered over lot boundaries. Also try to keep easement lines parallel to property boundaries lines. No building footers or underground structures are permitted to be built in an easement. In most cases, trees must be cleared from and kept out of the easements. In the event of a minor leak or a major break in the main, the main must be readily accessible to repair crews and vehicles.

2.2.1.3.5. Labeling: On plan views, label easements as "W/S" and include the width dimension, for example, "30' W/S EASEMENT". In an effort to reduce drawing clutter, the label may refer to the general notes. The W/S identification is to discourage use by electrical, telephone, storm drain, cable TV and other utilities.

2.2.1.3.6. Townhouses and Multifamily Areas: Some private developments prefer to establish privately maintained (that is, non-dedicated) road right of ways in which County owned and maintained water mains are situated. During the planning stages of the project, the engineer shall consult with the Bureau of Water and Sewer to develop an acceptable plan for delineating the water easement configuration on the plans.

2.2.1.3.7. Notice of Encroachment: When a water main is to be routed through lands owned by agencies of the County, for example, Bureau of Parks and Recreation, the design engineer must initiate a Deed of Notice of Encroachment and Right to Retain Easement. This establishes a valid water main easement on record in the event the County agency transfers ownership of the land in the future.

## 2.2.2. Diameter

2.2.2.1. Minimum Public and Private: The minimum size water main for serving two or more fire hydrants shall be 8-inch diameter. Otherwise, the minimum size for accommodating one hydrant shall be 6-inch. Larger size mains will be required as necessary to accommodate the required fire flow and peak domestic flow while maintaining the minimum residual pressure specified elsewhere in this Chapter.

2.2.2.2. Transmission Mains: For water transmission mains originating from treatment plants or storage reservoirs, the size of the main will be based on a projected peak flowrate that is based upon simultaneous occurrence of required fire flowrates and peak hourly domestic flowrate.

2.2.2.2.1. Maximum Velocity: The diameter shall be sized for a maximum velocity of 5 feet per second (fps) at non-fire flow conditions. The engineer shall furnish confirming calculations for approval.

2.2.2.2.2. Maximum EDU: A maximum of ten (10) EDUs may be connected to a 4-inch diameter line. The engineer shall furnish confirming calculations for approval.

### 2.2.3. Depth

2.2.3.1. Cover: Normal cover over water mains shall be a minimum of 3.5 feet to the crown of the pipe from finished grade.

2.2.3.2. Maximum Depth: Depth of water mains shall not exceed 7.5 feet to the crown of the pipe without Bureau of Water and Sewer approval.

### 2.2.4. Pressure

2.2.4.1. Maximum and Minimum: All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under conditions of fire flow. The normal working pressure in the distribution system shall be no greater than 100 psi and not less than 35 psi at the first floor elevation (at the meter outlet.)

2.2.4.2. Pressure Boosting: If in certain areas, the County system cannot provide 35 psi, the developer will be required to furnish storage or on-site booster pumping systems so as to obtain necessary service pressures.

2.2.4.3. Pressure Reduction: In certain instances, where the County system provides pressures greater than 100 psi. The developer will be required to furnish in-line or meter vault pressure reduction devices so as to obtain necessary service pressures.

### 2.2.5. Hydraulics

2.2.5.1. Sewer to Water Flowrate Relationship: Flowrate calculations for ultimate sizing of water mains, pumps, etc. may need to take into account that the total average daily flowrate for domestic EDUs must be multiplied by a factor of 1.4. This factor is based upon actual County data obtained during summer seasonal lawn sprinkling.

### 2.2.6. Materials

2.2.6.1. Pipe: Almost always, ductile iron pipe and fittings manufactured to AWWA standards is used for water mains. No PVC or other plastic pipe is permitted.

2.2.6.2. Joints: For joint design, see *Standard Specifications*.

## 2.2.7. Fire Protection

2.2.7.1. General: When fire protection is to be provided, water main design shall be such that fire flows and facilities are in accordance with requirements of the State Fire Marshall and of the State Insurance Services Office.

2.2.7.2. Sizing Booster Pumps, Water Mains, Etc.: The design hydraulic flowrate for fire hydrants shall be as provided in the Division of Utilities and Solid Waste management Rules and Regulations. After construction, hydrants will be color coded according to their required flowrate capacity by the DUSWM Department of Operations and Maintenance.

2.2.7.3. Sprinkler Systems: For single and multiple family dwellings, townhouses, and commercial projects that require sprinkler systems, the engineer should consult with the Division of Utilities and Solid Waste Management, Department of Engineering and Planning.

2.2.7.3.1. Adequate water at the meter outlet during sprinkler demand and major water appliance demand combined flowrates. Larger service connection piping and meter may be required, especially when water pressure is less than 45 psi.

2.2.7.3.2. Adequate backflow prevention to keep stagnant sprinkler water (also ethylene glycol) from flowing back into the County's system.

2.2.7.3.3. Enlarged private property piping to maintain pressure to sprinklers under high flowrate conditions. Complete information and meter details, i.e., meter size, pipe size, vault size, etc. shall be shown on the plans.

## 2.2.8. Dead Ends

2.2.8.1. Requirements: In order to provide increased reliability of service, reduce head loss, and avoid taste complaints, occurrences of dead ends shall be minimized by looping mains or providing tie-ins where appropriate.

2.2.8.2. Fire Hydrants: No more than one fire hydrant is permitted on an unlooped 6-inch main.

2.2.8.3. Maximum Number of Dwellings: No more than 25 single family or townhomes may be serviced on a dead end or cul-de-sac regardless of the street configuration.

2.2.8.4. Private: Commercial and industrial developments that have privately owned and maintained water mains shall provide on-site looping for fire protection and overall system reliability, where necessary.

2.2.8.5. Flushing Devices: Where dead-end mains occur, flushing devices other than the Bureau of Water and Sewer standard shall produce flows that will provide a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

## 2.2.9. Alignment

2.2.9.1. General: The horizontal and vertical alignment of water mains must be made to follow changes in street alignment of to pass safely over or around obstructions. These changes in alignment may be made by either use of bend fittings or by pipe joint deflections.

2.2.9.2. Curved Alignments: When the alignment of a water main is to be curved without using bend type fittings, see *Standard Details* for the permissible deflection radii. Indicate the appropriate radius of curvature in the plan or profile view.

2.2.9.3. With Other Utilities: Generally, other utilities shall parallel water mains and conform to design standards for horizontal and vertical clearance requirements set forth elsewhere in this manual.

## 2.2.10. Main Appurtenances

### 2.2.10.1. Valves

2.2.10.1.1. Sizes: Mains 4 inches to 24 inches require valves of the same size as the main. Butterfly valves shall be provided for sizes 16-inch in diameter or greater. Position indicators shall be furnished for all butterfly valves. Valves smaller than 16-inch shall be resilient-seat (R-S) gate valves. Mains larger than 24 inches may require valves smaller than the main, if approved by Bureau of Water and Sewer.

2.2.10.1.2. Division Valves: All division valves (that is, valves interconnecting two pressure zones) shall be resilient seat gate valves for all sizes.

2.2.10.1.3. Locations: All mains are to be valved at connections to larger mains. Valves shall be installed on the system at such places to isolate sections as may be necessary. This is typically achieved by placing four (4) at each cross and three (3) at each tee, with the exception of fire hydrant tees. Valves shall be installed on all fire hydrant leads as close to the water main as possible. Spacing of valves shall generally be as follows:



Main Size	Max. Valve Spacing
4"	400 feet**
6"	800 feet*
8" thru 12" (Residential Land Use)	1000 feet*
8" thru 12" (Other Land Use)	1200 feet*
16" (with service connections)	1200 feet
16" (no connections)	2000 feet
Over 16"	3000 feet

\* In townhouse or single-family areas, no more than 25 units shall be serviced between two valves.  
 \*\* No more than 10 units may be serviced with this size main unless hydraulic calculations are provide proving adequacy.

2.2.10.1.4. Tapping Sleeves and Valves: Tapping sleeves and valves shall be used when more than 20 domestic services would be shut off during an installation of a standard tee. The main being tapped may be the same size as the proposed main or tapping valve.

#### 2.2.10.2. Valve Vaults

2.2.10.2.1. Valve Boxes in Lieu of Vaults: For butterfly valves on mains 16 inches and smaller, gate valves 12 inches and smaller and for tapping valves 16 inches and smaller, use County standard adjustable valve box as shown in the *Standard Details*.

2.2.10.2.2. Required Vaults: For gate valves on mains larger than 12 inches, reinforced concrete vaults as shown in the *Standard Details* shall be used. \*\* DETAIL NOT YET DEVELOPED \*\*

2.2.10.2.3. Tapping Valves: For tapping sleeves and valves, or tapping assemblies and valves on mains larger than 16 inches, indicate vaults as shown in *Standard Details*.

2.2.10.3. Fittings: Fittings shall be of a material as stated in the *Standard Specifications*. All fittings shall be precisely shown with a symbol and identified as to size and type, on plan and profile views. Use of ninety-degree (1/4 bend) bends are discouraged, their use must be approved by the Bureau of Water and Sewer.

#### 2.2.10.4. Fire Hydrants

2.2.10.4.1. General: Water mains not designed to carry fire flows shall not have fire hydrants connected to them. Minimum fire hydrant design flow rate requirements are set forth in the Appendix.

2.2.10.4.2. Single Family Residential: Hydrants must be provided at each street intersection and at intermediate points between intersections measured 500 feet along an improved road, in single family residential areas. The most distant corner of any proposed dwelling shall have hydrant coverage.

2.2.10.4.3. Multi-family Residential: Hydrants must be provided at each street intersection and at intermediate points between intersections measured 300 feet along an improved road, in multi-family residential areas. The most distant corner of any proposed dwelling shall have hydrant coverage.

2.2.10.4.4. Arterial Roads: Fire hydrants shall be located along major highways. Fire hydrants shall be located along interstates, where feasible and accessible. If the highway is divided (monumented), hydrants shall be located alternately on either side of the highway.

2.2.10.4.5. Other: All other uses of property, including commercial shopping centers, malls, industrial high-rise, or elevator-type condominiums and apartments shall meet the requirements aforesaid and provide hydrants within both the front and the rear of the aforementioned buildings. A hydrant shall be provided within 100 feet of sprinkler or standpipe fire department connections.

2.2.10.4.6. Yard Hydrants: Yard hydrants and hose bibs that are privately maintained and are likely to be used for non-fire fighting activities, for example, landscape watering, pavement washing, etc., shall utilize metered water.

2.2.10.4.7. Reference: See the *Standard Details* and Section 2550 of the *Standard Specifications* for approved types of hydrants and installation requirements.

2.2.10.4.8. Configuration: If a hydrant is located at the end of a line and not connected to a tee, then joint restraint shall be used to enable the removal of the hydrant for either repair or the possible extension of the line.

#### 2.2.10.5. Air Release Valves

2.2.10.5.1. Location: Air release valves (ARV) or combination vacuum release valves shall be installed at prominent peaks on long supply mains 8 inches and larger, when no customer connections are within 25 feet of the crest.

2.2.10.5.2. Interdictions: Automatic ARV's shall not be used in areas subject to flooding from streams, inlet spreads, or other surface runoff.

2.2.10.5.3. Manual: Manual ARV's are not to be used without written permission of County.

#### 2.2.10.6. Blow-offs

2.2.10.6.1. Permanent: A fire hydrant blow-off shall be installed at the end of each dead end main.

2.2.10.6.2. Temporary: Shall be designated for areas that are being constructed in phases and will be extended in the future.

2.2.10.6.3. Valleys: Blow offs shall be placed at the extreme and other prominent low points in all size mains for the purpose of sediment removal and draining the line for repairs.

#### 2.2.11. Service Connections

##### 2.2.11.1. Location

2.2.11.1.1. WSCs shall be shown on all relevant contract drawings from the main to the property line or as directed by the Bureau of Water and Sewer. WSC piping is always located in a right of way or easement, except for the end portion connecting to the meter that portion is located about 1 foot inside the private property line.

2.2.11.1.2. WSC piping passing in close proximity to sewers can be protected by installing the piping in a suitable sleeve. Sleeved piping is also required for certain routings beneath State Highways.

2.2.11.1.3. WSCs shall be located 5 feet upstream from the center line of property to be served and SSCs shall be 10 feet downstream from the water. It is important to locate the WSC (meter) in a predictable location to facilitate locating the WSC in the event

it becomes buried by subsequent construction or site grading. If driveway locations are known, avoid placing meter vaults and piping in or under the paved portion.

2.2.11.1.4. Double WSCs (DWSC) (that is when two meters are supplied to one connection pipe) may be permissible in certain existing single family residential developments as approved by DUSWM, Department of Engineering and Planning. In locating meters at property corners, make every effort to avoid conflicts between the meter vault and driveway areas. Double service connections are only permitted with the 5/8-inch meter and standard vault. Double service connections cannot be used when a pressure reduction valve or sprinkler service is involved.

2.2.11.1.5. Connection Crossing Property Boundary: When a particular private property site has no access to a County water main except by routing water piping through a second private property site, it is incumbent upon the owner requesting the water service to obtain a perpetual 10-foot wide easement on said second site. The easement must abut the existing right-of-way or easement containing the water main and extend to the property receiving the water service. The WSC can be established with the meter located about 1 foot inside the said second site. Such installations are to be avoided unless compelling reasons are presented to the Division of Utilities and Solid Waste Management for approval. Approval of all interested County agencies is also required, especially Planning and Zoning.

#### 2.2.11.2. Sizing

2.2.11.2.1. In most cases, the size of the connection piping is determined by the size of the meter selected. When the situation involves combinations of long runs of connection piping, sprinkler demands, commercial demands or low pressure gradient in the main, the piping shall be over size.

2.2.11.2.2. Large Connections: Service connections 3 inches and larger must be designed showing detail of service connection piping, vault, and vault bypass piping in both plan and profile.

#### 2.2.11.3. Meters

2.1.11.3.1 General: See Section 2550 of the *Standard Specifications* and pertinent *Standard Details* for residential services. Commercial and industrial

services must be individually sized on a case by case basis by the design engineer. The designer is urged to reference the AWWA Manual M6, *Water Meters — Selection, Installation, Testing, and Maintenance*.

2.2.11.3.2. Meters: Meters are required for fire service. See the *Standard Details*.

2.2.11.3.3. Meter Vaults: Vaults for meter installations must be as indicated in the *Standard Details*. Custom meter vaults may be necessary in certain instances and will require review and approval by the County.

2.2.11.3.4. Location: For some industrial and commercial applications, the meter may be installed inside the customers building in a special metering room.

2.2.11.3.5. Pressure Reduction Valves: At site locations where the water pressure gradient exceeds 100 psi for a few number of service connections, a combination pressure reduction valve and meter are situated in the meter vault. See the *Standard Details*.

2.2.11.3.6. Unimproved Lots: (Intentionally left blank)

2.2.11.3.7. Abandonment: If the design calls for an existing WSC to be disconnected, the plans must show special instructions for capping off the piping.

2.2.11.3.8. Road Excavations: WSCs that must cross an existing County or State road requires a permit. The methods must be specified for construction. See Road Excavations this Chapter.

## 2.2.12. Clearances

2.2.12.1. Water Main Crossing Sanitary Sewer, Force Main, Storm Drain, Other Utilities: Water main shall have a minimum vertical clearance of 1 foot outside diameter to outside diameter (OD to OD) above the sewer or other utility. Horizontal crossing angles shall not be less than 45 degrees.

2.2.12.2. Water Main Parallel to Sanitary Sewer or Force Main: Where sewer and water mains or other utilities are less than 10 feet apart, water mains shall be vertically above sewers a minimum of 6 feet. Where more than 10 feet apart, water mains shall be 1 foot above the sewer or other utilities.

2.2.12.3. Exceptions: When the aforementioned clearances are not practical, the sewer shall be encased and indicated on the plan and profile. Special joints may be required on the water or sewer main, as specified by the County. See the *Standard Details*.

## 2.2.13. Structural

2.2.13.1. General: Main pipe and fitting wall thickness shall be sufficient to accommodate internal operating and surge pressures, vacuums, and active and passive earth loads. The structural design of water main piping shall conform to AWWA standards except as modified herein.

2.2.13.2. Design: Typically, for ductile iron pipe, the design procedure is as follows:

2.2.13.2.1. Design for internal pressures (static pressure plus water hammer allowance)

2.2.13.2.2. Design for external loads (earth load plus H-20 truck loads).

2.2.13.2.3. Use the larger resulting wall thickness.

2.2.13.2.4. Add a 0.08-inch service allowance.

2.2.13.2.5. Add a standard casting tolerance (3 to 8-inch, 0.05 inches); (10 to 12-inch, 0.06 inches).

2.2.13.2.6. Calculate total wall thickness and determine standard pressure class of pipe, (that is, 150 or 350 psi).

2.2.13.3. Buttresses and Anchorages: Bends, tees, and dead ends shall be anchored or buttressed, as shown in the *Standard Details*.

2.2.13.4. Joint restraint: Restraints such as Megalug<sup>R</sup> or mechanical joint retainer glands are required for unstable soil conditions, areas of congested utilities, stream crossings, uncontrolled fill, dead ends for future extensions, possible soil failure during emergency excavation and repair, etc. The number of joints to be restrained shall be delineated and noted on the plans. See the *Standard Details*.

2.2.13.5. Areas of Structural Fill: Wherever water mains are to be constructed in areas of structural fill, the design engineer shall consider any special requirements that may be deemed necessary by the County. Note the special requirements on the plans.

2.2.13.6. Steep Slopes: Wherever water mains are constructed at slopes greater than 5:1, special anchoring is required. See the *Standard Details*.

#### 2.2.14. Road Excavations

2.2.14.1. General: Water mains that penetrate the rights-of-way of MSHA, County, railroad, or other utility upon which there exists pavement or other features that may not be disturbed and, therefore, require the employment of tunneling or boring techniques, shall be designed to accommodate these methods of construction. The design engineer shall, after a preliminary review by the Bureau of Water and Sewer, be responsible for securing written approval of the technique(s) and permits as required from the utility, railroad, or agency whose right-of-way is being penetrated. The County will assist in securing approval where it is deemed necessary.

2.2.14.2. Bore and Jack Pipe: Water pipe under State and/or County roads shall be installed in a tunneled or jacked sleeve, as required by the State Highway Administration or County Highway Department in their respective right-of-ways. Water pipe and sleeves under railroads shall be designed according to specifications of the railroad being crossed. The beginning and end stations for the sleeves shall be shown in profile. See the *Standard Details*.

2.2.14.3. Open Cut: In instances where open cut methods of installation are proposed, the conditions of the permit must be clearly shown on the plans. A copy of the permit must be secured and on file with the Bureau of Water and Sewer before the County will approve the plans.

#### 2.2.15. Tapping Main

2.2.15.1. General: When the water main must be tapped to provide service to a property site, the design engineer must perform necessary research and investigation to achieve a sound design. If construction of the main was somewhat recent, the County has as-built records of the size, type of material, wall thickness, and location of the water main. If records are not available, test pitting may be required to determine requirements for tapping the main.

2.2.15.2. Wet Tapping: Wet tapping, that is, tapping the main while it remains pressurized, is generally preferred. Wet tapping can be achieved either with a corporation cock threaded into the main or with a tapping sleeve and valve. Typically, mains can be directly tapped and threaded when the diameter and wall thickness are sufficiently large in comparison to the size of the threaded opening. Tapping sleeves are typically used when the existing main would be structurally weakened if tapped without the sleeve.

2.2.15.3. Cut-in Tapping: Another method of tapping a main is to take the main out of service, dewater it, cut it, and install necessary fittings, valves, etc. When no valves are available to isolate a portion of a main to allow dewatering, a

Hydrostop(s)<sup>R</sup> can be utilized to insert fittings, valves or other appurtenances while the main is under pressure. This method must be approved by the Bureau of Water and Sewer and noted on the plans. A detailed sequence of construction must be prepared and coordinated with this Bureau.

2.2.15.4. Authority: The method of tapping and conditions for any interruptions to other customer's water service pressure must be indicated on the plans. The design engineer shall consult the Bureau of Water and Sewer to develop the method of tapping.

#### 2.2.16. Cross Connection Control

2.2.16.1. Backflow Prevention Devices: In situations where the customer's private piping is deemed by the County to have reasonable potential to cause contaminated back flow into the County's water main, suitable back flow prevention devices are required.

2.2.16.2. Interconnection With Wells: Interconnection of piping that supplies County public water with privately owned well supplies are NOT permitted. When County water is connected to a property with wells, all wells on the property must be permanently sealed and abandoned pursuant to State law.

2.2.16.3. Liability: The US EPA charges the purveyor of water service accountable for any injuries caused by water contaminated originating from a customer's connection.

2.2.16.4. Siamese Connections: When building exteriors provide siamese fittings for connection of fire trucks, a backflow preventer is required. When sprinkler systems employ ethylene glycol to prevent freezing or contain stagnant water, back flow prevention is required.

2.2.16.5. Commercial and Industrial: Where industrial or commercial operations expose the building water system to biological or chemical contamination, back flow prevention is required.

#### 2.2.17. Stream Crossings

2.2.17.1. Above-water Crossings are not permitted.

2.2.17.2. Underwater Crossings: A minimum cover of 3.5 feet shall be provided over the pipe with appropriate stream protection. When crossing water courses that are greater than 10 feet in width, the following shall be provided:

2.2.17.2.1. Restrained joints or concrete encasement shall be required the full length of the crossing.



2.2.17.2.2. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding.

2.2.17.2.3. Pipe thickness shall be a minimum of two (2) classes above the minimum specified in the *Standard Specifications*.

2.2.17.3. Whenever water mains cross under streams or drainage ditches, the minimum cover shall be 3.5 feet, or as directed by the Bureau of Water and Sewer or the agency regulating the crossing of the waterway, usually the Water Resources Administration. Pipe shall be mechanical joint utilizing Megalug<sup>R</sup> joint restraint, or pipe manufacturer's equal, at each joint through the said crossing.

2.2.17.4. Streambank restoration design must be in accordance with the latest Water Resources Administration regulations and waterway construction permit. Plans must clearly delineate the actual limits of disturbance, restoration, dewatering basins, etc.

2.2.17.5. Stream crossings of pipes exceeding 8 inches shall furnish a dewatering device. Provisions shall be made to collect the drained liquid in a manhole or other containment structure to facilitate its removal by portable pumping vehicles, only when the discharging of the liquid directly into the waterway is not permitted. Provisions for vehicular access shall be provided.

## CHAPTER 3. -- SEWER MAIN DESIGN

### 3.1. DESIGN REQUIREMENTS

3.1.1. Availability of Sewer: Designers shall check with the Bureau of Water and Sewer to determine the availability of sewer service to the site of proposed subdivision or connection.

#### 3.1.2. Definitions

3.1.2.1. Building Drain: Represents the piping that conveys wastewater down through a building and terminates at the connection to the building sewer. Usually the building drain pipe terminates at the building exterior wall. The building drain is owned, constructed and maintained by the property owner. Design and construction of building drain pipes are regulated by the County Plumbing Code and the County Plumbing Inspector.

3.1.2.2. Building Sewer: Represents the piping that connects to the building drain and conveys wastewater to the SSC at the property line. The building sewer is owned, constructed and maintained by the property owner. Design of building sewer piping is regulated by the County Plumbing Code and construction is inspected by the Division of Construction Management.

3.1.2.3. SSC: Represents the piping that originates at the cleanout at customer's property or easement line and terminates at the County's sewer main. The SSC is owned and maintained by the County and is always located in a public right of way or a sewer easement. In most cases, each SSC will correspond to a particular water service customer account. On drawings, the SSC is called out by the abbreviation, SSC. SSCs are often referred to as sewer laterals. The maximum number of properties served by one service connection pipe is two.

In rare instances, a grinder pump owned and maintained by the County will be situated on private property. The grinder pump receives the flow of wastewater through the building sewer from the house or building and pumps it through a force main pipe to a gravity sewer main or a pressure main. It is incumbent on the property owner to grant an easement to the County for maintenance of the grinder pump and associated force main. Cost of electric power for the grinder pump is at the expense of the property owner.

3.1.2.4. Collector Sewer: Main line sewer typically serving three or more properties. It is usually located in the street or a sewer easement and receives wastewater from various SSCs and conveys the wastewater by gravity to another collector or interceptor. Typical diameters are 8-inch, 10-inch, and 12-inch. Design and construction of collector sewers are regulated by DPW.

3.1.2.5. Interceptor Sewer: Main line sewer that receives wastewater from a number of collector sewers and conveys it by gravity to a treatment plant. Interceptor sewers are owned and maintained by the County. Typical diameters are 14-inch and larger. Interceptor sewers are located in a public right of way or a sewer easement. Design and construction of interceptor sewers are regulated by DPW.

3.1.2.6. Outfall Sewer: Main line sewer that either conveys wastewater from an isolated subdivision to another collector or conveys treated wastewater effluent from a treatment plant to a receiving stream. Design and construction of outfall sewers are regulated by DPW.

3.1.2.7. Force Main: Force main (sewer) conveys wastewater under pressure from a sewer pumping station to a point, usually at a higher elevation, where the wastewater changes to gravity induced flow. Design guidelines for force mains are given in Chapter 4. Design and construction of force mains regulated by DPW.

### 3.1.3. Responsibility

3.1.3.1. County Sewer System: After completion of construction, the sewer system is maintained by the County. The parts of the system that are owned and maintained by the County includes SSC cleanouts and piping, grinder pumps and associated force mains, sewer mains, manholes, sewer pumping stations, force mains, sewer treatment plants, and treated effluent outfall pipes. The sewer system elements owned by the County are always located in or on County-owned property, in public rights-of-way or in water easements on privately owned property. Sewer related elements that are situated within private property (and not in a sewer easement) are maintained by the property owner.

3.1.3.2. Private Systems: Some large commercial sites operate sewer collection systems to serve their sites that include sewer mains, manholes, etc. that are owned by the site owner. It is important to show clearly the limits of the private system and note this on the plans.

3.1.4. Tributary Population: Sewer systems that provide for a complete sewershed shall be designed and sized, taking the following into consideration:

3.1.4.1. The estimated future tributary population that follows the Water and Sewer Plan and the applicable regional comprehensive plan.

3.1.4.2. The entire watershed shall be assumed to be completely developed according to present zoning or to the comprehensive plan's proposed zoning.

3.1.4.3. Sewer systems that initially provide service for only a part of a complete watershed shall be sized and built to provide for the entire watershed. Otherwise, provision shall be made for future increased capacity. Proper consideration to allow for the characteristics, that is, domestic, commercial, and industrial wastes and groundwater infiltration of the area under consideration shall be made. When a sewer plant is to be built in modules, DPW shall decide the initial capacity to be constructed and the size of future modules.

3.1.4.4. Supporting data shall be shown in the pre-design report or on the plans. Major collector and interceptor sewers require a design analysis that utilizes the form provided in the Appendix.

### 3.1.5. Flow Projection

#### 3.1.5.1. Quantity of Flow

3.1.5.1.1. Population Equivalent: In sanitary engineering practice, it is generally accepted that a person will generate 100 gallons of sewage per day. From a hydraulic loading standpoint, 100 gallons of sewage per day represents one person called "one population equivalent." This equivalent population flow, 100 gpd, has been regarded as the upper limit for domestic flow projection as a daily average.

3.1.5.1.2. Equivalent Dwelling Unit (EDU): For design planning, the County uses the population equivalent for residential areas shall be 2.5 persons per dwelling, or 250 gpd per dwelling. In doing flow projection calculations the term EDU is used and is equal to 250 gpd per dwelling.

3.1.5.1.3. Commercial: For commercial lots the flow projection shall be based upon the guidelines shown in the Appendix. Sewer flows are based on sewer connection unless the use creates a flow type not specified in the Appendix, then the flow will be established by the Bureau of Water and Sewer on a case by case basis.

3.1.5.2. Average Daily Flow: Average daily flow is the arithmetic sum of the average daily domestic flow plus the average daily commercial flow plus the average daily industrial flow plus any other average daily flows from the service area. The average daily commercial, industrial, and other flows shall be based on the period in which these flows are generated. For purposes of the calculating flows here, the term flow is equivalent to flowrate, that is, volume of water per unit time.

3.1.5.3. Peaking of Flows

3.1.5.3.1. Peak Flow: Peak flow is the average daily domestic flow peaked in accordance with the MDE curve in the Appendix.

3.1.5.3.2. Peak Commercial and Industrial: Peak commercial or industrial flow is the average daily commercial or industrial flow peaked in accordance with the MDE curve in the Appendix. When pertinent data is available, the commercial or industrial flow can utilize a peaking factor higher than the MDE curve.

3.1.5.3.3. Summation of Flows: The average daily domestic flow, average daily commercial flow, and average daily industrial flow shall be combined and then peaked using the MDE curve in the Appendix. When pertinent data is available, the commercial and industrial flows can utilize a peaking factor higher than the MDE curve. In all instances, the peaking is applied before the I & I flows are added in.

3.1.5.3.4. Pumped Flow: Whenever pumped flow enters a gravity sewer, the peak flow shall be equivalent to the pumping rate.

3.1.5.4. Infiltration and Inflow (I/I)

3.1.5.4.1. Design: For design purposes, the upper limit of allowable infiltration and inflow within the areas of the project is 400 gallons per inch diameter per mile per day.

3.1.5.4.2. Planning: For planning purposes, the upper limit of an allowable infiltration and inflow within the area of the project can be assumed to be 200 gallons per acre per day.

3.1.5.5. Design Hydraulic Flow

3.1.5.5.1. Design Hydraulic Flow: Design Hydraulic Flow = Peak Domestic Flow + Peak Commercial Flow + Peak Industrial Flow + Infiltration and Inflow Allowance. This provides the maximum flowrate value that is to be used as the basis for preparing designs.

### 3.2. DESIGN

#### 3.2.1. Location

3.2.1.1. General: Sewer mains shall be routed in a public right of way whenever possible. Sewer mains are generally located at least 7 feet from a private property line or easement when line is parallel to the property line.

#### 3.2.1.2. Right-of-Ways

3.2.1.2.1. New Subdivisions with Pavement, Curb and Gutter: Collecting sewers or force mains shall, where practical, generally be placed 7 feet from the center line of the street right-of-way and no less than 5 feet from the face of the curb or proposed curb (on the opposite side of the street from the water main). Where it is not feasible for manholes to be located within the pavements, they shall be located wholly within a grass plot or wholly within the sidewalk. Sewers shall not bisect a curb longitudinally at an angle of less than 30-degrees.

3.2.1.2.2. New Subdivisions with Pavement and No Curb: Collecting sewers or force mains shall, where practical, be placed located 5 feet from the center line of the street right-of-way (on the opposite side of the street from the water main). Where it is not feasible for manholes to be located within the pavements, they shall be located wholly within a grass plot or wholly within the sidewalk.

3.2.1.2.3. Existing Developments with Pavement and Curbs: Collecting sewers or force mains shall be located after full consideration is given to all existing and proposed facilities within the dedicated right-of-way.

3.2.1.2.4. Existing Development with Pavement and No Curbs: Collector sewers and force mains shall, where practical, generally be located outside of the edge of pavement on the opposite side of the street from the water main, except that the sewer shall not be situated under a future curb or within a ditch line. The location of other existing and proposed facilities within the right-of-way shall be fully considered.

3.2.1.2.5. Along Existing State and County Roads: Sewer main locations shall be such that the edge of trench is no closer than 2.5 feet from the edge of the roadway, where practical.

### 3.2.1.3. Easements

3.2.1.3.1. General: When it is necessary to route or locate sewer mains in a non-public right of way or non-Bureau of Water and Sewer-owned land area, then the engineer shall proceed to establish water and sewer easements to be deeded to the County. The statutory six foot easement at the periphery of building lots is generally considered to be reserved for non-water and sewer utilities.

3.2.1.3.2. Through Public and Private Properties: Where the routing of a sewer main intrudes into or through public and/or private properties, the design engineer shall give a thorough analysis of its impact upon all existing and/or proposed physical features of the site. In all cases, the design engineer must initiate the necessary deed of easement to the County.

3.2.1.3.3. Size: Standard width for sewer easements is 30 feet. Even if there is only one pipeline, such as an 8-inch sewer, 30-foot width is required. If one sewer pipe is involved, position the pipe with a 10/20-foot offset than at the 15/15-foot centerline of the easement. The offset permits a second vehicle to pass around a backhoe that is centered over the pipeline. When two pipelines are in the easement, they shall be positioned at 10/10/10. On terminal sewer mains, easement shall extend at least 15 feet beyond the axis of the manhole.

3.2.1.3.4. Configuration: Easements for sewer mains shall be configured from straight line segments and be of uniform width, that is, 30 feet. Avoid routing easements through the central interior area of building lots. Whenever possible, keep easement centered over lot boundaries. Also try to keep easement lines parallel to property boundaries lines. No building footers or underground structures are permitted to be built in an easement. In most cases, trees must be cleared from and kept out of the easements. In the event of a minor leak or a major break in the main, the main must be readily accessible to repair crews and vehicles.

3.2.1.3.5. Labeling: On plan views, label easements as "W/S" and include the width dimension, for example, "30' W/S EASEMENT". In an effort to reduce drawing clutter, the label may refer to the general notes. The W/S identification is to discourage use by electrical, telephone, storm drain, cable TV and other utilities.

3.2.1.3.6. Townhouses and Multifamily Areas: Some private developments prefer to establish privately maintained (that is, non-dedicated) road right of ways in which County owned and maintained sewer mains are situated. During the planning stages of the project, the engineer shall consult with the Bureau of Water and Sewer to develop an acceptable plan for delineating the sewer easement configuration on the plans.

3.2.1.3.7. Notice of Encroachment: When a sewer main is to be routed through lands owned by agencies of the County, for example, county parks, the design engineer must initiate a Deed of Notice of Encroachment and Right to Retain Easement. This establishes a valid sewer main easement on record in the event the County agency transfers ownership of the land in the future.

### 3.2.2. Diameter

3.2.2.1. Minimum Diameter: No main line gravity sewer conveying raw sewage shall be less than 8 inches in diameter.

3.2.2.2. Minimum Service Connection: No service connection piping shall be less than 6 inches in diameter. See the *Standard Details*.

### 3.2.3. Depth

#### 3.2.3.1. Main

3.2.3.1.1. General: Sewers shall be designed sufficiently deep to receive sewage from basements. The use of ejector grinder pumps is discouraged in new construction; use of grinder pumps in new construction is permitted only in extraordinary circumstances as determined by the Bureau of Water and Sewer.

3.2.3.1.2. Minimum: The minimum depth of a main line gravity sewer shall be 3.5 feet to prevent freezing and pipe deformation. Sewers with less than 3.5 feet of cover are permitted only in instances where the horizontal distances does not exceed 100 feet.

3.2.3.1.3. New Subdivisions: New residential subdivisions shall be designed to serve a finished basement. If desired, the minimum basement elevation may be shown on the plans. If townhouses are to be constructed on slabs, they must be noted and a finished slab elevation may be provided on the plans.



3.2.3.1.4. Commercial and Industrial Parks: Commercial and industrial lots shall provide the most remote corner of the proposed building with gravity sewer service.

3.2.3.1.5. Improved Lots: Sewer main inverts shall be a minimum of  $2' + h$  below cellar elevations where  $h$  = feet of distance between the building setback line and the sewer multiplied by the required house connection slope of 0.02. (Use actual building location, if known, instead of building line.) For buildings or houses without cellars, sewers shall be a minimum of  $2' + h$  below first floor elevations. In all cases, sewer main depth shall be sufficient to meet criteria established for house connection, depth, grade, and clearance.

3.2.3.1.6. Unimproved Lots: For unimproved lots, maximum sewer depth as controlled by adjacent lots shall not exceed 10 feet. Where lots can be expected to be filled to the level of the established grade, depth, as regulated by adjacent house connections, shall normally not exceed 8 feet. Greater depth may be required to clear future storm drains. In all cases, depth shall be sufficient to meet criteria established for house connection depth, grade, and clearance.

3.2.3.2. Other: See Service Connections in this Chapter.

### 3.2.4. Hydraulics

3.2.4.1. Manning's Formula: Computations for velocity of flow shall be based on the Manning formula using values of "n" contained in the Appendix.

3.2.4.2. Maximum Velocity: The maximum permissible flow velocity under peak conditions shall be 15 feet per second for all pipe materials. Suitable drop manholes shall be provided to break the steep slopes to limit the velocities in the connecting sewer pipes between manholes. Where drop manholes are impractical for reduction of velocity, the sewer shall be of ductile iron or other abrasion resistant material.

#### 3.2.4.3. Slope

3.2.4.3.1. Requirements: The following are minimum slopes, as required by MDE, for main line sewers in feet per hundred feet. When a pipe is flowing full, the minimum slope provides a velocity of two feet per second.

Sewer Size	Minimum Slope in Feet Per 100 Feet
8-inch	0.40
10-inch	0.28
12-inch	0.22
15-inch	0.15
18-inch	0.12
21-inch	0.10
24-inch	0.08
27-inch	0.067
30-inch	0.058
36-inch	0.046
42-inch	0.040

3.2.4.3.2. Terminal Sewers: Terminal sewers require a minimum slope double those indicated above.

3.2.4.3.3. Minimum for Service Connections: Piping in service connections has a minimum slope of 2%, based on the *Standard Specifications*.

3.2.4.4. Head Losses at Manholes: Miscellaneous head losses at manholes and junctions shall be allowed for as follows:

3.2.4.4.1. At manholes on straight runs, allow head loss of 0.05 feet.

3.2.4.4.2. The radius of turn is shall not be less than two pipe diameters, therefore for calculations allow 0.25 times the velocity head. Velocity head = velocity (in feet per second) squared, divided by 64.4. In no case shall total allowance be less than 0.05 feet.

### 3.2.5. Materials

3.2.5.1. Pipe: Material for gravity sewer mains and connection piping are typically PVC. Large diameter sewer utilize DIP and RCP.

3.2.5.2. Manholes: Manholes are typically pre-cast concrete.

3.2.5.3. Other: See the General Standards and Specifications for currently approved materials.

### 3.2.6. Alignment

3.2.6.1. Mains: Gravity sewer main lines are always aligned by a laser beam straight from manhole to manhole. No designs using deflection at the joints is permitted. Manholes must be used at all changes in horizontal or vertical alignment. Flow in manholes is not permitted to turn more than 90 degrees.

3.2.6.2. Service Connections: Gravity SSC piping is shown preferably as being perpendicular to the main line in plan view. Angled connections to the main, as viewed in plan, are under review by the Bureau of Water and Sewer. Service connection piping must always show as a straight run of pipe from the main to the cleanout at the property line, in plan. Changes in vertical alignment are permitted and will appear in profile.

### 3.2.7. Manholes

#### 3.2.7.1. General

3.2.7.1.1. *Standard Details*: Manhole details are shown in the *Standard Details*. The designer shall use these standards as required by the design situation and shall designate the detail number on the contract drawings. Invert of outgoing pipe must drop a minimum of 0.1 feet from any incoming pipes.

3.2.7.1.2. Numbering: Manholes shall be numbered sequentially beginning with the number 1 at the lowest manhole invert elevation and progressing accordingly upstream. When the design calls for connection of a proposed sewer to an existing manhole, the existing manhole retains its existing number.

#### 3.2.7.2. Location

3.2.7.2.1. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections of flow.

3.2.7.2.2. Location in Unimproved Areas: All manholes located in unimproved areas shall be constructed with the rim one (1) foot above existing or finished grade, whichever is greater. Rim elevations shall be provided for all manholes.

3.2.7.2.3. Except for terminal manholes, which are allowed to accommodate as many as three service connections, any non-terminal manhole is allowed no more than two service connections. Service connections are permitted only within 180 degree envelope that is perpendicular to the outlet pipe as seen in plan view.

3.2.7.2.4. A minimum of 12 inches clearance from outside diameter to outside diameter must be provided on the manhole wall between connecting pipes. Use a larger diameter manhole if necessary to increase clearance. As a rule of thumb, for two 8-inch pipes connecting to a typical 48-inch diameter manhole, 12 inches of clearance is provided if the pipelines are at greater than 50 degrees included angle as seen in plan view.

3.2.7.2.5. A lamphole cleanout may be used in lieu of a terminal manhole only for special conditions and in no case be installed at the end of a main segment greater than 150 feet in length. When used, call out Det. 212 on the plans and label as a lamphole, that is, "IH-1".

3.2.7.2.6. Manholes shall be spaced at distances not greater than 400 feet for sewers 15 inches in diameter or less, and 500 feet for sewers 18 inches in diameter. Distances up to 600 feet may be approved by the Bureau of Water and Sewer in cases where adequate modern cleaning equipment for such spacing is readily available.

3.2.7.2.7. Spacing greater than 600 feet may be permitted in sewers larger than 18 inches with prior written approval from the Bureau of Water and Sewer.

3.2.7.2.8. Sewers greater than 24-inches in diameter shall not be permitted to make 90-degree turns in one manhole. Two manholes with 45-degree turns must be furnished at a minimum.

3.2.7.2.9. No manholes shall be located within the flood area of storm water management ponds or ponds with a permanent pool.

### 3.2.7.3. Drop Type

3.2.7.3.1. Drop manholes must be used, for certain pipe diameters, when the invert of an incoming main is more than 0.5 feet above the invert of the flow channel of the manhole. Drop manholes cause a reduction in flow velocity and splashing, thereby avoiding odors and erosion.

3.2.7.3.2. Reference the *Standard Details* for specific dimensions.

3.2.7.3.3. Drop manholes can be constructed with either an inside or an outside drop connection. Development of a standard detail for an inside drop connection is in progress.

3.2.7.3.4. Drop manholes shall not be utilized for main diameters greater than 15-inches.

3.2.7.3.5. The construction drawings shall show the drop with a symbol and indicate the type of drop in the profile view. Two 12-inch diameter inside drop connections shall require a 60-inch or 72-inch diameter manhole.

3.2.7.4. Diameter

3.2.7.4.1. Manholes shall have a diameter of 48 inches for use with pipes 24 inches or less in diameter.

3.2.7.4.2. For pipes greater than 24 inches, a 72-inch diameter manhole shall be used.

3.2.7.4.3. In special instances, use of a 60-inch diameter manhole is permitted.

3.2.7.5. Flow Channel

3.2.7.5.1. The flow channel through manholes must be made to conform to shape and slope to that of the sewers. See the *Standard Details*.

3.2.7.5.2. For all new manholes that include service connections, all incoming pipes must have the same incoming invert. Drop connections of main lines will have an additional invert above the flow channel invert.

3.2.7.6. Joints: Use of grout to seal PVC pipe connections to a manhole is not permitted. Grout does not adhere well to PVC material. See standard detail for flexible seal. When tapping into an existing manhole to provide connection for another main or house connection pipe, the flexible joint must be specified. Existing manholes not originally constructed to County standards may require replacement of the entire manhole. The engineer shall be responsible for scheduling a mutual field meeting with the Bureau of Water and Sewer for an official determination of replacement.

3.2.7.7. Watertightness

3.2.7.7.1. Watertight manhole covers are to be used wherever the manhole lids may be flooded by street or overland runoff.

3.2.7.7.2. Watertight manhole covers shall be used where the manhole is located within the 100-year floodplain, or in areas that are historically flooded more frequently than the 100-year probability.

3.2.7.7.3. Watertight manhole covers shall be utilized when the rim is within 8 feet of a curb.

3.2.7.7.4. Watertight lids shall be furnished on all manholes that are in close proximity to storm water management ponds.

3.2.7.8. Changes in Pipe Diameter: At manholes where a smaller diameter main discharges into a larger diameter main, the invert of the larger main shall be lowered so that the energy gradients of both mains remain at the same level. Generally this condition will be met by placing the crowns of the two mains at the same elevation.

3.2.7.9. Vents

3.2.7.9.1. Vents shall be provided a minimum of every 1500 feet, when watertight manholes are utilized consecutively along the said distance.

3.2.7.9.2. The top of the vent shall be a minimum of one (1) foot above the 100-year flood elevation. The vent shall be protected from flooding debris and vandalism. The vent protection design shall be approved on a case by case basis by the Bureau of Water and Sewer. See the *Standard Details*.

3.2.7.10. Monitoring Manholes

3.2.7.10.1. Requirements: Monitoring manholes (see *Standard Details*) are required at all commercial and industrial sites and at any location that has the potential, as deemed by the Bureau of Water and Sewer, to discharge toxic or otherwise harmful waste into the County's sewer system. Monitoring manholes serve at least three purposes. First, they enable verification of compliance with the County's pretreatment requirements and permits. Second, they enable detection of point sources of waste that require pretreatment and are not permitted by the County. Third, they enable quick verification that a sewer user is not contributing to a problem in the sewers.

3.2.7.10.2. Pipe Angles: The angle between the inflow and outflow pipes must be 180 degrees, with no exceptions. Slope of the incoming pipe cannot be greater than 2 %.

3.2.7.10.3. Inverts: Manhole inverts shall be high enough to prevent backups from the mainline from affecting flow measurements. Invert elevation drop through a monitoring manhole is zero feet.

3.2.7.10.4. Stabilization of Flow: Flows into the monitoring manholes must be laminar and stabilized. Generally this is accomplished by providing a minimum of 25 pipe diameters of straight pipe before entering the manhole.

3.2.7.10.5. Flume Requirements: When required because of the Standard Industrial Classification Code (SIC Code) for a particular sewer user, a flow measuring device shall be included with the Monitoring manhole. The device shall be a Palmer-Bolus flume or equivalent.

3.2.7.11. Electrical: Electrical equipment installed in or used in manholes shall be UL listed, explosion-proof, and resistant to corrosion from either sewer gases or immersion in sewage.

### 3.2.8. Service Connections

#### 3.2.8.1. Location

3.2.8.1.1. SSCs shall be shown with symbol for the pipe and cleanout on plan view of the drawings. The connection is between the main and the property line or as directed by the Bureau of Water and Sewer. SSC piping is always located in a right of way or easement, except for the end portion (cleanout) that is located about 1 foot inside the private property line. Minimum slope of connection piping is 2% as required by the *Standard Specifications*.

3.2.8.1.2. Connection Crossing Property Boundary: When a particular private property site has no access to a County sewer main except by routing sewer piping through a second private property site, it is incumbent upon the owner requesting the sewer service to obtain a perpetual 10-foot wide easement on said second site. The easement must abut the existing right of way or easement containing the sewer main and extend to the property receiving the sewer service. The SSC then can be established with the cleanout located about 1 foot inside the said second site. Such installations are to be avoided unless compelling reasons are presented to the Bureau of Water and Sewer for approval. Approval of all interested County agencies is also required, especially planning and zoning.

3.2.8.1.3. SSCs shall be located 5 feet downstream from the center line of property to be served and SSCs shall be 10 feet downstream from the water. It is important to locate the SSC (cleanout) in a predictable location to facilitate locating the SSC in the event it becomes buried by subsequent construction or site grading.

3.2.8.1.4. Invert depth of the cleanout at the property or easement line is a critical factor when designing sewer service to a property site. Minimum depth (cover) is 3.5 feet to prevent freezing (see minimum depth requirements elsewhere in this chapter). Minimum cleanout elevation (relative to the mainline) is determined by computing: main invert elevation at the connection + main pipe diameter in feet +  $(0.02 * \text{horizontal distance from main to cleanout.})$  Show cleanout invert with a symbol ---●--- and the station of the SSC in the profile view. Provide the elevation of the cleanout in either plan or profile.

3.2.8.1.5. Sewer Service Drop Connections (SSDC) are required either to raise the elevation of the cleanout when the cleanout location is in such a way that the connecting pipe would be sloped greater than 5%. The design engineer shall evaluate each SSC to determine if it is standard or drop. If the drop connection is used, it must be called out in profile view, that is, SSDC in order for the contractor to price the installation correctly. SSDC to manholes shall be avoided unless there are compelling reasons. When such is employed, the preferred method is to use an internal drop pipe in the manhole.

3.2.8.1.6. Manhole Connections: Extending SSCs from proposed manholes is acceptable. Invert of the connection is always 0.1 feet or higher in elevation than the outlet invert of the manhole. Extending SSCs from existing manholes is acceptable under certain conditions. If the manhole was not constructed to acceptable standards, wall penetrations may severely weaken the structural integrity. Replacement of the manhole may be required. Invert of the connection to the existing manhole shall be about 6 inches below the top of the bench; however, if an internal drop can be used with a 90 degree elbow at the top of the bench, then the bench can remain intact.

3.2.8.1.7. Double SSCs (DSSC) (that is when two properties drain to one connection pipe) are permissible under special circumstances.

3.2.8.1.8. Crossings: SSCs that must cross an existing County or State road requires a permit. The methods must be specified for construction. See Road Excavations in this Chapter.



### 3.2.8.2. Sizing

3.2.8.2.1. In most cases of single family residential connections, the size of the connection piping is determined by the 6-inch minimum in the standard detail. For commercial developments with high flows, the piping shall be sized to accommodate any peak flows with substantial safety factor.

3.2.8.2.2. Service connections 8 inches and larger, must be designed with complete pictorial detail of service connection piping in plan and profile.

3.2.8.3. Abandoning Connections: If the design calls for an existing SSC to be disconnected, the plans must show special instructions for capping off the piping.

### 3.2.9. Clearances

3.2.9.1. Sewer Main Crossing Water, Force Main, Storm Drain, Other Utilities: Sewer main shall have a minimum vertical clearance of 1 foot outside diameter to outside diameter (OD to OD) below the other utility. Horizontal crossing angles shall not be less than 45 degrees

3.2.9.2. Sewer Main Parallel to Water, Force Main, Storm Drain, Other Utilities: Where sewer and water mains or other utilities are less than 10 feet apart, water mains or other utilities shall be vertically above sewers a minimum of 6 feet. Where more than 10 feet apart, sewer mains shall be 1 foot below the water or other utility.

### 3.2.10. Structural Design

3.2.10.1. General: The Design Guidelines together with the *Standard Specifications* and details provide standardized practices that have demonstrated good performance. However, it is incumbent on the design engineer to question the structural adequacy of the design under preparation to verify that structural failures will not occur. Unusual soil conditions, deep installations, heavy vehicular traffic, may require supplementary specification to the County's standard practices. The structural design of sewers shall conform with the methods given in the *ASCE Manual No. 37 for the Design and Construction of Sanitary and Storm Sewers*, except as modified herein.

3.2.10.2. Mainline: Typically, PVC, SDR 35 pipe is used for construction of the County's collector sewers. When bedding and backfilling is according to the *Standard Specifications* and details, no additional specification has been required unless there are unusual soil conditions. For 8-inch PVC pipe installed

deeper than 14 feet, SDR 26 that has greater wall thickness shall be called out on the profile view. For situations such as lack of enough cover or construction of stream crossings that require additional strength, ductile iron pipe is used in place of PVC. If there is a possibility that the pipeline may be exposed from stream erosion, then concrete encasement of ductile iron pipe is required. For sewers installed on slopes of 20% or greater, concrete anchors are used, see *Standard Details*.

#### 3.2.11. Road Excavations

3.2.11.1. General: Sewer mains that penetrate the rights-of-way of MSHA, County, railroad, or other utility upon which there exists pavement or other features that may not be disturbed and, therefore, require the employment of tunneling or boring techniques, shall be designed to accommodate these methods of construction. The design engineer shall, after a preliminary review by the Bureau of Water and Sewer, be responsible for securing written approval of the technique(s) and permits as required from the utility, railroad, or agency whose right-of-way is being penetrated. The County will assist in securing approval where it is deemed necessary.

3.2.11.2. Jacking Pipe: Water pipe under State and/or County roads shall be installed in a tunneled or jacked sleeve, as required by the State Highway Administration or County Highway Department in their respective right-of-ways. Sewer pipe and sleeves under railroads shall be designed according to specifications of the railroad being crossed. The beginning and end stations for the sleeves shall be shown in profile. See the *Standard Details*.

3.2.11.3. Open Cut: In instances where open cut methods of installation are proposed, the conditions of the permit must be clearly shown on the plans. A copy of the permit must be secured and on file with the Bureau of Water and Sewer before the County will approve the plans.

#### 3.2.12. Tapping Mains

3.2.12.1. General: When designing sewer piping that requires tapping into an existing sewer system, the design engineer shall consult with the Bureau of Water and Sewer to make plans for diverting the sewer flow while construction take place. Special instructions for diverting the flow must be shown on the plans.

3.2.12.2. Dog-house Manholes: Tapping main lines to accommodate another main requires a new manhole be constructed over the existing main. Use of a dog-house type manhole may facilitate the construction.

3.2.12.3. Service Connections: Tapping main lines for a SSC typically requires a tapping saddle. Tapping saddles are not usually obtainable when the diameters of the existing main and the proposed connection pipe are equal.

3.2.13. Inverted Siphons (Sag Sewers)

3.2.13.1. General: Inverted siphons shall be used sparingly and only after all alternative designs have been determined as impracticable.

3.2.13.2. Requirements: Inverted siphons shall have not less than two barrels with a minimum pipe size of 6 inches and shall be provided with necessary appurtenances for convenient flushing and maintenance; the manholes shall have adequate clearance for rodding; sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows. The inlet and outlet details shall be so arranged that the normal flow is diverted to one barrel and in such a manner that either barrel may be cut out of service for cleaning and/or maintenance.

3.2.13.3. Easements: Additional right-of-way will be required for access and maintenance to the siphon structures. Structures shall be placed in close proximity to a paved street. If a street does not exist, a design must be submitted and approved by DPW.

3.2.14. Pretreatment

3.2.14.1. General: Sewer service customers who are involved in activities that have the potential to discharge non-conforming waste, for example, toxic substances, solids, chemicals, oil, grease, etc. must provide pretreatment control to continue to discharge into the County sewer. Additionally, wastewater from customers cannot be too hot or discharged in slugs or surges to the extent that the discharge interferes with normal operation of the sewers. When required, the property must complete a SIC questionnaire with the Bureau of Water and Sewer's Division of Operations and Maintenance.

3.2.14.2. Monitoring Manholes: During design phases of industrial and commercial projects, the engineer shall consult with the aforementioned County agencies to assure that no improper waste discharges occur. Monitoring manholes may be required as mentioned in elsewhere in this Chapter. Customarily, vehicular repair and restaurant operations require a grease trap. Complete specifications for the installation of the grease trap (or other pretreatment device) must be shown on the plans.

3.2.15. Stream Crossings

3.2.15.1. Above-water Crossings shall not be allowed.

3.2.15.2. Underwater Crossings: A minimum cover of three feet shall be provided over the pipe with appropriate stream protection. When crossing water courses that are greater than 10 feet in width, the following shall be provided:

3.2.15.2.1. Restrained joints or concrete encasement shall be required the full length of the crossing.

3.2.15.2.2. Force mains shall have valves provided at both ends of sewer crossings so that the section can be isolated for testing or repair. The valves shall be easily accessible, and not subject to flooding.

3.2.15.2.3. Pipe thickness for DIP gravity sewers and force mains shall be a minimum of two (2) classes above the minimum specified in the *Standard Specifications*.

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## CHAPTER 4. — PUMPING STATIONS

### 4.1. GENERAL

#### 4.1.1. Design Standards

4.1.1.1. General: The complete design discussed in the following sections represent standardized practice by the County and conformance thereto will be obligatory for all pumping stations except when directed to the contrary by the Bureau of Water and Sewer. Unless otherwise directed in Chapter 4, all provisions of Chapter 1 apply as minimum requirements. The complete design, as approved by the Bureau of Water and Sewer, shall be bid and constructed as ONE contract by the developer. Specialties such as paving and landscaping shall NOT be performed by the County or "others".

4.1.1.2. State Review: All water and sewer pumping stations that serve more than two (2) homes require a design review by the Maryland Department of the Environment (MDE). Construction permits for these stations are also issued by MDE. MDE has issued design requirements in the *Design Guidelines for Sewerage Facilities*, Technical Bulletin: M-DHMH-EHA-S-001. However, MDE has no issued design guidelines for water pumping stations. For reference purposes, users of this manual shall consult *The Recommended Standards for Sewage and/or Water Works*. In the event that either of the aforementioned design standards conflict, the more stringent requirement must meet or exceed MDE design conditions.

4.1.1.3. Operation Experience: These County standard design guidelines are based not only on recognized textbook and regulatory provisions, but also experience and standard operating/maintenance (O & M) procedures. Operations and maintenance functions are presupposed, but not limited to the following goals: ease of access for maintenance, standardized tools and equipment, reduced parts inventory, predictability of maintenance needs, and reliability of interfacing equipment. With these goals in mind, the County may specify manufacturers and associated equipment for use in all pumping stations.

4.1.1.4. Noise Control: All water and sewer pumping stations shall be designed to minimize noise in accordance with COMAR 26.02.03 or the latest revision thereto.

#### 4.1.2. Preliminary Design

4.1.2.1. General: Pumping station designs have the potential for a wide variety of configurations. It is difficult for these design guidelines to provide a simple sequence of steps that will lead to the final design without the need for numerous reviews and revisions. Nevertheless, if the designer learns and follows these guidelines, it will expedite the County design review process and greatly reduce the number and complexity of reviews.

4.1.2.2. Analysis: An analysis of any existing collection system and the impact of the estimated contributed flow must be performed by the engineer and submitted to the County prior to the commencement of any design. Prior to making detailed drawings and specifications, the designer shall perform a hydraulic analysis together with a graphic sketch plan and submit the same to the County for review and comment.

4.1.2.3. Other Considerations: In terms of preliminary planning for detailed drafting, major design considerations include but are not limited to: need for emergency power, number of and type of under/above ground structures, complexity of controls, waterhammer, odor control, and to what degree a package design could be used as opposed to a custom design.

#### 4.1.3. Design Drawings

4.1.3.1. General Requirements: Drawings for pumping stations shall provide adequate graphic treatment to various design aspects including: site plan, electrical, landscaping, sediment/erosion control, details, hydraulic criteria, pump/system curves, architectural and plumbing schematic.

##### 4.1.3.2. Site Plan

4.1.3.2.1. General: One site plan shall indicate all major features of design and provide adequate detail to describe properly the pump station and its appurtenances.

4.1.3.2.2. Scale: All plans applicable to the site (site and grading, landscaping, sediment control, etc.) shall be prepared at a scale no smaller than 1-inch = 20 feet.

4.1.3.2.3. Locations: Location and size of structures, mechanical and electrical components must be dimensioned and drawn to scale. Provide profile views as necessary to show critical vertical locations.

4.1.3.2.4. Topography: Existing and proposed contours shall be provided at one-foot intervals.

4.1.3.2.5. Other Features: All existing and proposed physical features within 100 feet of the pump station's property line shall be shown.

4.1.3.2.6. Dimensioning: Provide adequate dimensioning to locate structures, specify pavement widths, utility spacing, etc. All dimensions shall be tied to a non-destructable or an easily recovered point, such as: property corners, existing buildings, or other permanent landmark.

4.1.3.2.7. Indicate contract limits if the station is to be constructed in another phase, by others, etc.

4.1.3.3. Electrical

4.1.3.3.1. Provide complete plan layout indicating all conduit sizes, wire sizes, and equipment locations, including lighting and other appurtenances. Show all conduits (buried and non-buried) locations inside and outside of all buildings that are existing or proposed.

4.1.3.3.2. Installation details of equipment that is wall mounted, or suspended from the ceiling, or otherwise required for clarity.

4.1.3.3.3. Single line schematic diagrams incorporating all electrical components required for operation of the facility.

4.1.3.3.4. Complete lighting schedule stating the model, size, location, and installation data as well as appurtenances. Vandal-proof exterior lighting shall be provided, when required.

4.1.3.3.5. Complete control and alarm diagrams.

4.1.3.3.6. Riser diagram for bubbler system with operating conditions.

4.1.3.3.7. Elevation of control panels with dimension, and properly identifying each component.

4.1.3.3.8. Complete circuit breaker schedule indicating size, and identifying each circuit.

4.1.3.3.9. Ventilation equipment schedule giving fan size, operating conditions, location, model, installation data, etc., and outlining louver data, such as fixed, motorized, size, material, etc.

4.1.3.3.10. Provide a legend for all symbols used for the above.

4.1.3.3.11. Secondary power facilities and alarm equipment shall be designed so that they may be manually activated for periodic maintenance checks to ensure proper operation.

4.1.3.4. Landscaping

4.1.3.4.1. Conifers are the preferred decorative landscaping treatment for newly designed pumping stations. All other shrubbery and planting shall be low-maintenance and hardy for this region of the country. Consideration shall be given to maintenance



equipment in the selection of landscaping treatments. Under no circumstances shall large trees, shrubs, etc. obstruct maintenance vehicles, that is, vector truck booms during routine work.

4.1.3.4.2. A landscaping plan shall be prepared showing planting arrangement of shrubs and trees, etc.

4.1.3.4.3. Identify each by both genetic names as well as common names, and specifying size and planting information in a schedule format with a legend.

4.1.3.4.4. Provide special planting details and specifications as applicable to each species.

4.1.3.5. Sediment and Erosion Control

4.1.3.5.1. A sediment control plan and site development plan shall be provided in accordance with the Soil Conservation Service (SCS) requirements and the *Standard Specifications*.

4.1.3.5.2. All SCS signature blocks, details, notes, etc. shall be provided and approved by SCS.

4.1.3.6. Design Details

4.1.3.6.1. Plan views, profiles, sections, etc. shall be provided for valve vaults and other above or below ground structures.

4.1.3.6.2. Any other structure or appurtenance that cannot be adequately described in general notes or is not standard, shall be detailed appropriately.

4.1.3.6.3. Fencing shall be provided if controls, generators, etc. are not enclosed in buildings or other approved enclosures.

4.1.3.6.4. Pavement details indicating various course thicknesses shall be furnished on the design drawings.

4.1.3.6.5. Mechanical supports for equipment such as fans, controls, piping, etc. shall be detailed.

4.1.3.7. Hydraulic Criteria

4.1.3.7.1. List the following minimum information, in table format, directly on the construction drawings adjacent to the pump curve plot:

- Number of users, EDUs, etc.
- Peaking factor
- Total flow
- C-factors (pipe material)
- Length of force main
- Diameter of force main
- Static head (friction head)

4.1.3.7.2. Special hydraulic criteria not specifically mentioned above must be furnished when requested by the Bureau of Water and Sewer.

4.1.3.7.3. The design engineer shall fully investigate water hammer and provide additional necessary surge protection of the pumping stations as required, including surge tanks, as applicable. The use of solid state soft-start, soft-stop pump controls shall be investigated.

#### 4.1.3.8. Pump Curves

4.1.3.8.1. Pump performance curves represent a plot of the performance characteristics of a pump in terms of a curve plot of a range of fluid flowrates through the pump versus the corresponding total dynamic pressure heads (TDH) produced by the pump. If a hydraulic gradient diagram is being constructed, the TDH is approximately equivalent to the hydraulic grade at the pump.

4.1.3.8.2. Pump curves are developed by operating the pump at a constant speed with the fluid hydraulics in any connecting piping stabilized. Flowrate data versus pressure data is then recorded. Flowrates are varied using a valve for throttling. Manufacturers' tests of pumps are usually performed with water.

4.1.3.8.3. Prior to proposing a particular pump for a design application, the designer should be thoroughly familiar with the pump curve in terms of the manufacturer's recommended operating ranges, the best efficiency, suction head requirements, and the brakehorse power required to drive the pump.

#### 4.1.3.9. System Curves

4.1.3.9.1. System curves represent a plot of the performance characteristics of a piping system to which a pump is to be connected. System curves are developed by the designer using basic principles of hydraulics. Similar to pump curves, the system curve is a curve plot of a range of flowrates through the piping system versus the total dynamic pressure heads required by the system.

4.1.3.9.2. The system curve is an aggregate of three curves: static head, dynamic head, and minor head losses. Static head represents the net pressure head seen by a pump connected to the system when no fluid is moving. Static head is normally computed by taking the difference in elevation between the highest point in the piping system and the lowest point. Dynamic head, on the other hand, represents the total head required to move the fluid through the system when accounting for fluid friction losses. Minor losses represent head losses due to fluid friction in fittings such as: elbows, reducers, check valves, gate valves, flow meters.

4.1.3.9.3. To plot the friction head versus flowrate, either the Hazen-Williams or the Darcy-Weisbach equations are acceptable. Common friction coefficients for various pipe materials can be found in the appendix.

#### 4.1.3.10. Pump and System Curves

4.1.3.10.1. The system curve shall be plotted and superimposed on the manufacturer's pump curve. The intersection of the pump and system curve determines the operating point of the pump that is directly associated with the pipe distribution system. Curves that are submitted to the County, shall be accompanied by hydraulic calculations and pipe distribution system diagrams so that the development of the curve plots can be verified. All system curves shall be superimposed or reillustrated on the design drawings.

4.1.3.10.2. Curve plots shall be furnished on the contract drawing. All data that is not relevant to the development of these curve plots shall be omitted. Pump operating points shall be labeled with all coordinates identified.

4.1.3.10.3. Adjacent to the curve plot, the designer shall provide the computation of the total static head. The length, diameter and friction coefficients shall be provided in a tabular form.

4.1.3.10.4. In many cases, particularly with potable water pumping stations, more than one system curve must be developed because the distribution system changes during various pump operating conditions. Suction and discharge pressures may vary widely because of changes in storage tank levels or large draft conditions. A minimum of two curves are required. One curve shall represent the most favorable conditions sustained by the pump and the other curve shall represent the most unfavorable conditions the pump could sustain.

4.1.3.10.5. The specifications for the pump shall include the following information:

- # of pumps
- Discharge nozzle size (in.)
- Suction nozzle size (in.)
- Maximum design speed (rpm)
- Design capacity (gpm)
- Design TDH (feet)
- Efficiency at design point
- Brake horsepower required at the maximum design point
- Minimum solid size (in.)
- Net positive suction head required at the maximum flow design point (ft.)
- Secondary design capacity (gpm)
- Secondary TDH (ft.)
- Efficiency at second point, minimum
- Impeller diameter (in.)
- Motor horsepower

4.1.3.11. Architectural

4.1.3.11.1. Elevation views shall be furnished for all four sides of buildings. Indicate compass directions.

4.1.3.11.2. Floor plans shall be at a scale no smaller than 1/2" = 1'-0".

4.1.3.11.3. See County Department of Permits and Inspections for the "yellow book".

4.1.3.12. Plumbing Schematic

4.1.3.12.1. For piping smaller than 4 inches in diameter, an isometric diagram shall be furnished that indicates fittings, valves, sizes, etc.

4.1.4. Specifications

4.1.4.1. Specifications, if they are not too lengthy, may be directly incorporated into the design drawings. Otherwise, the specifications shall be on 8½-inch x 11-inch paper, bound and submitted concurrently with the design drawings for review.

4.1.4.2. Specifications shall be in a format that is similar to the CSI specification designations.

#### 4.1.5. Cost Estimates

4.1.5.1. At the conclusion of the design process, the engineer shall prepare a detailed cost estimate for the pumping station for review and approval by County. This estimate shall be developed for each major category of work including civil, mechanical, electrical, structural, architectural work, and contingencies.

#### 4.2. SITE SELECTION AND DESIGN

##### 4.2.1. Locations

4.2.1.1. The locations must be specifically determined for each project based on various criteria applied to potential sites. In addition to satisfying the functional needs of the system it serves, the site location must be evaluated as to its visual, odor and noise impact on the surrounding neighborhoods.

4.2.1.2. The design engineer shall take into account the surrounding environment of the site and provide a site design that is aesthetically appealing to existing as well as any future development of surrounding areas.

4.2.1.3. Pump stations and their associated entrance roads shall be located a minimum of two (2) feet above the 100-year floodplain. Under no circumstances shall stations and entrance roads be located within a floodway, even if the elevation is two (2) feet above the 100-year floodplain by using current information. Also, avoid locations vulnerable to overland drainage and erosion.

4.2.1.4. In locating the pumping station and supplemental above ground facilities, the design engineer shall ensure compliance with existing County ordinances regarding land use, set back requirements, etc. and if required, prepare all data, and obtain any variance(s) to existing zoning regulations to be in conformance as necessary.

4.2.1.5. Land required for pumping stations is obtained for ownership by County (fee simple) including a 20-foot wide fee simple panhandle right-of-way for vehicular access routes to an existing or proposed public roadway. If two utilities are to be present within the 20-foot panhandle, a minimum of five (5) additional feet of easement is required on either side of the panhandle for maintenance purposes. As part of this process, a survey of the property is required, together with a record plat and a metes and bounds description of the parcel.

4.2.1.6. Existing drainage problems must be investigated and corrected.

#### 4.2.2. Site Size

4.2.2.1. In determining the space requirements of the facility, particular attention shall be given to width provided for the access road to insure adequate space for grading and drainage within the purchased land. Future expansions of the facility shall be fully considered.

4.2.2.2. The designers goal shall be to meet all applicable zoning requirements for public utilities, when possible.

#### 4.2.3. Land Acquisition and Dedication

4.2.3.1. Pumping station sites and any necessary land space for access routes to the nearest public thoroughfare shall be acquired by the developer in fee simple. The site will then be deeded to County.

4.2.3.2. The pumping station site shall be deeded to County prior to construction.

#### 4.2.4. Layout

4.2.4.1. Location of all proposed facilities required for the pumping station site shall be clear and concise to permit a complete field stakeout from the site plan.

4.2.4.2. Parking and Turnarounds: A minimum of two parking spaces shall be provided. Adequate paved area shall be provided for a tandem three-axle sludge truck for vehicle access and turnarounds. All paving shall be in accordance with County Standards for Local Roads.

4.2.4.3. Access Road: The pumping station shall be readily accessible to maintenance vehicles by an access road, minimum 10 feet wide, paved in accordance with County Standards for Local Roads. The road shall be centered in a minimum 20-foot wide fee simple right-of-way. A 3% grade for a landing area shall be provided a minimum of 30 feet from the public street. The station shall be located outside the public street right-of-way, or where deemed necessary by County. Standard pavement specification is 2-inches of surface course on 4-inches of base course.

4.2.4.4. Traverse Information: All locations of proposed facilities shall be projected from a traverse, and/or base line established from the traverse, in which case the base line shall be located so that it will not be interrupted by the proposed construction. Location of proposed facilities shall not be referenced from other proposed facilities for stakeout purposes.

4.2.4.5. Grading: Grading around the pumping station site shall have a maximum side slope of 3:1 unless otherwise approved by County. On flat sites, spot shots shall be provided to insure positive drainage away from the site.

4.2.4.6. Topography Limits: Existing contours and other topography shall be shown for the entire site including 100 feet minimum outside of proposed property boundary. Contour interval shall be one foot.

4.2.4.7. Utilities: Water and sewer lines shall be located at the edge of the pavement of the access road when possible. Supply dimensions of their respective locations.

#### 4.2.5. Soil Investigations

4.2.5.1. At least two soil borings will be taken at the building, wet well, and dry well locations etc. to determine soil types, rock, water table elevations, soil bearing values, etc. These boring logs will be included on the contract drawings or specifications. A soils report outlining the recommendation of the design must be submitted at 50% design completion.

#### 4.2.6. Fences

4.2.6.1. The building and any vital outside appurtenances shall be enclosed with a 6-foot high chain link fence (fabric height), having a 12-foot wide double leaf vehicle gate across the driveway or a single 6-foot wide roll gate

4.2.6.2. Fences shall be bonded green or black vinyl to be topped with three strings of barbed wire See *Standard Specifications* for more details.

4.2.6.3. Fences shall be required for pump stations that have no above-ground structures. The placement of controls below ground level is not permitted, as this will further aggravate confined space regulations.

4.2.6.4. Pumping stations that have long driveways (up to the fenced portion of the site) shall be provided with a locking drop bar type gate (at the driveway entrance) to prevent loitering.

#### 4.2.7. Signage

4.2.7.1. A permanent sign, in accordance with the County Code, shall be provided at each pumping station reading "Frederick County, Pump Station Name, Pumping Station No. \_\_\_\_\_, Emergency Telephone Number (301) 694-2194." \*\* A standard detail will be developed. \*\*

#### 4.3. STRUCTURAL/ARCHITECTURAL

##### 4.3.1. Above ground structures

4.3.1.1. The building designed to house pumping equipment and/or electrical controls systems shall conform to the County Building Code and latest revisions thereto.

4.3.1.2. Buildings (generators, controls, etc.) with exposed superstructures shall be architecturally compatible with surrounding structures. Buildings shall utilize maintenance free and structurally significant materials (such as brick masonry units) on the exterior. Vinyl siding shall not be used.

4.3.1.3. Buildings shall be designed to be vandal-proof. Under no circumstances shall windows be provided. The use of wood doors is also not permitted.

4.3.1.4. For small precast structures, Smith Cattle Guard Easi-Set Multi-Purpose Building<sup>R</sup> or approved equal may be used.

4.3.1.5. Provisions shall be made in the structure for traversing monorails with cranes of adequate capacity to facilitate the removal of pumps, motors, valves, and all other related heavy equipment.

##### 4.3.2. Below Ground Structures

4.3.2.1. Confined Spaces: The engineer shall emphasize eliminating the need for maintenance personnel to enter the OSHA definition of a confined space.

4.3.2.2. Buoyancy calculations must be furnished on all underground structures such as: wet wells, dry wells, large vaults, etc.

4.3.2.3. No steel underground structures are permitted for either temporary or permanent installations.

4.3.2.4. Fiberglass stations or structures that are double wall thickness may be considered for very small installations only. See the definition on pump station classifications elsewhere in this chapter. Fiberglass structures must withstand backfill and earth pressure without deformation or puncture.

4.3.2.5. Precast concrete shall be used for wet wells, dry wells, valve vaults, etc.

4.3.2.6. Underground walls shall be provided with external waterproofing.

##### 4.3.3. Roofing

4.3.3.1. Roofing shingles shall be at a minimum of 30-year fiberglass. Shingles or other roofing materials shall be consistent with similar residential architecture in the area.



4.3.3.2. Flat roofs are not permitted on small buildings.

4.3.4. Flooring

4.3.4.1. Floors shall be reinforced concrete and sloped to a central floor drain. Floor shall be sealed with a clear rubber-based smooth finish. Finished floor shall be a minimum of 6 inches above finished grade to minimize flooding of the building.

4.3.4.2. Grating shall be aluminum or fiberglass meeting Federal and State safety requirements.

4.3.5. Locks

4.3.5.1. Doors are to be UL listed, heavy duty, insulated, metal and fire-resistant with deadbolts and locks keyed to the Water and Sewer Department system.

4.3.5.2. Internal panic hardware shall be furnished on all open-out doors.

4.3.6. Handicap Accessibility

4.3.6.1. Control buildings shall be constructed to be barrier-free. Floor plans, when applicable, must be submitted for approval.

4.3.7. Lighting Requirements

4.3.7.1. Outside area lighting shall be dusk-to-dawn lamps with shatter-proof bulbs and no outside switches.

4.3.7.2. An outdoor ground fault interrupter (GFI) receptacle shall be furnished with a switch or breaker in the equipment control panel.

4.3.8. HVAC

4.3.8.1. Because control panels are to be enclosed in a building (to eliminate the hazard maintenance personnel experience repairing control panels in a driving rain), regardless of the size of the station, electric space heating shall be considered for all stations. Provisions also shall be made, if applicable, to insure against condensation forming on controls and other major items of equipment.

4.3.8.2. Dehumidifiers and sump pumps are to be furnished for all under ground structures, except wet wells.

4.3.8.3. Provide calculations showing that excess heat from pumps and other equipment will be adequately removed from the building. Otherwise, air conditioning is required to keep electrical equipment from failing.

4.3.8.4. A ventilation duct diagram shall be required, when applicable, with appropriate air flow directional arrows.

#### 4.3.9. Fixtures

4.3.9.1. If potable water is available to the site, sinks shall be furnished for personal sanitation. Reduced pressure backflow preventers are required on all potable water supplies to pump stations.

4.3.9.2. If chemical treatment is utilized at a pumping station, eye washes, sinks, etc. will be necessary.

#### 4.3.10. Penetrations

4.3.10.1. Walls: All penetrations (such as conduits, pipes, etc.) to wet wells, valve vaults, walls, etc. shall be gas and liquid tight.

4.3.10.2. Floors: Floor penetrations shall utilize steel or PVC sleeves.

#### 4.4. POWER REQUIREMENTS

4.4.1. General: All electrical designs and components shall be in strict accordance with all applicable National Codes, County Codes NEMA and Potomac Edison (PE) requirements. It is incumbent on the design engineer to contact Potomac Edison to determine the type of electrical power available.

#### 4.4.2. Normal Power

##### 4.4.2.1. Voltage Phase Selection

4.4.2.1.1. Three-phase service available from Potomac Edison is 4-wire wye at either 277/480 or 120/208 volts. Compared to the 120/208 service, the 277/480 service requires less costly wire and switchgear, but a dry transformer is required for 120-volt appliances. For installations with pumps 5 horsepower and smaller, either three-phase power or 120/240 volt single-phase power can be used. However, the decision as to which voltage to use is based upon considering cost trade-offs among: the initial cost to bring electric service to the site; the costs for electrical equipment at the station; and the monthly user charges.

4.4.2.1.2. All installations with pumps over 5 horsepower require three-phase power. Pumping stations employing equipment that requires a non-standard voltage configuration that requires a step-up/down transformer will not be allowed.

4.4.2.2. Across the Line Starting: This is the preferred method of designing controls for motors 100 HP or less, even though a larger on-site generator is required. Permission shall be obtained from Potomac Edison prior to starting the electrical design.

4.4.2.3. Reduced Voltage Starting: Conventional reduced voltage and solid state starting systems shall be used for motors above 100 HP. Solid state controls shall have bypass contactors to reduce the generation of heat in the Thyristors. Potomac Edison will need the horsepower sizes of the electrical equipment to determine the degree of voltage reduction.

4.4.2.4. Typically the power company expects the contractor to install the meter socket (pedestal or wall mount) and the conduit from the meter socket to power source.

#### 4.4.3. Emergency

4.4.3.1. Dual power sources: Dual power sources for emergency operations of pumping stations shall be considered and thoroughly investigated and coordinated with Potomac Edison in all cases. The provision of dual power sources shall involve the connection to the station of two substantially independent power sources (separate substations). It shall be capable of automatic and manual start-up and cut-in with sufficient capacity to provide power for full station capacity, lighting, and ventilation as well as other systems necessary for the adequate operation of the pumping station during an outage of one of the sources.

4.4.3.2. Emergency power generator: The emergency power generator shall be capable of automatic and manual start-up and cut-in with sufficient capacity to provide power for full station capacity, lighting, and ventilation as well as other systems necessary for the adequate operation of the pumping station during a 24-hour power outage of the primary source.

4.4.3.3. The design engineer shall perform a complete cost analysis in determining the lowest cost alternative (between dual power source and emergency power generator) and provide the County with complete recommendations. The County prefers dual commercial power supply.

4.4.3.4. Provision of connection for hook up of a portable generator may be required by the Bureau of Water and Sewer.

#### 4.4.4. Power Circuits

4.4.4.1. Electric meters and main disconnect switches shall be placed on the exterior wall of buildings.

#### 4.4.5. Control Circuits

4.4.5.1. All pump controls shall be automatic and have manual controls in addition to the automatic controls, so that testing and maintenance of critical components can be performed.

#### 4.4.6. Motors

4.4.6.1. Where possible, all electric motors and equipment shall utilize energy saving characteristics and be highly efficient.

4.4.6.2. Each pump motor control circuit shall be equipped with phase loss protection so that individual motor starting circuits are prevented from operating during conditions of phase loss or reversal.

4.4.6.3. The pump motor horsepower, not including the motor service factor, shall be equal to or exceed the pump's maximum horsepower requirement. Motor service factors shall be reserved for electrical voltage variations only.

#### 4.4.7. Wiring and Cabling

4.4.7.1. Requirements for wiring and cabling shall be supplied either on the construction plans or the specifications.

#### 4.4.8. Grounding

4.4.8.1. Under no circumstances shall electrical grounding systems be connected directly to piping systems that carry water or wastewater. This contradicts the requirements of local code enforcement, however the NEC does not require such a connection and the prevention of potential stray currents causing electrolytic corrosion must be prevented.

### 4.5. WATER PUMPING STATIONS

4.5.1. General: The engineer shall make special reference to the National Fire Protection Association manual NFPA 820 in the design of pumping station electrical control and ventilation systems.

4.5.1.1. Design features of the structure and mechanical equipment shall take into account the functional requirements of pumping, automation, maintenance, personnel safety, and noise controls. Pumping units, design features, and mechanical appurtenances must be carefully selected by the design engineer for performance, reliability, and efficiency.

4.5.1.2. Backup power is required for all stations that provide fire flow or serve more than 25 homes where storage cannot supply average daily flow for at least four hours.

#### 4.5.2. Hydraulic Criteria

4.5.2.1. General: The pumping units shall be selected to satisfy both the initial and ultimate design hydraulic peak flows as described in Chapter 2, if feasible. If not feasible, then the pump capacity may be scaled down to accommodate the initial flow rate and an intermediate flow rate based on an approved interim state of development. Pumping units can be upgraded by

means of impeller changes, speed changes, or both. At least one standby pump shall be provided and shall be designed and equipped to be operational at all times. Pumps shall be of such capacity that with the largest unit out of service, the remaining pumps will deliver the peak flow.

4.5.2.2. A complete analysis of the hydraulic conditions of the system shall be made to determine average, maximum and minimum operating gradients, water hammer conditions, etc.

4.5.2.3. A sufficient number of system curves shall be developed to show design points, including the average daily flow (ADF) and fire flow conditions, to be satisfied by an individual pump as well as a number of pumps operating in unison.

4.5.2.4. The system curves shall be shown on the contract drawings and shall indicate a minimum of three (3) design points to be met by each of the design procedures for demonstrating the effects of pumping on the pipe system.

4.5.2.5. When required by the Bureau of Water and Sewer, hydraulic gradient diagrams shall be provided in addition to the system curves and shall be at a scale of 1 inch = 50 feet horizontal; 1 inch = 5 feet vertical, and shown on the Contract Drawings, indicating: hydraulic gradients, flows, velocities, friction coefficients, existing ground elevation, proposed pipe grades, and any other pertinent data.

#### 4.5.3. Pumps

4.5.3.1. Pumps for use in potable water pumping stations are generally to be centrifugal closed impeller type, horizontal split-case, electric motor driven, and are selected based on the maximum efficiency at the operating points of the system curve. In some instances, turbine pumps may be used in lieu of the type mentioned above, but will require the approval of County before substantial design is initiated.

4.5.3.2. A minimum of one standby pump shall be provided and available for service at all times. Additional pumps may be provided, depending on the flow rates to be accommodated as determined by the system curve. Typically, two jockey pumps and two fire flow pumps will be required as a minimum, but the designer is responsible for verifying this general requirement.

4.5.3.3. The number of pumps may be reduced by providing two speed operation or variable speed drive controls.

4.5.3.4. Pump discharge velocities shall typically be operated between 5 and 10 feet per second. Tank supplied systems shall have suction pressures maintained at a sufficient point to prevent cavitation.

4.5.3.5. In-line booster stations shall be located such that a minimum of 25 psig is maintained on the suction side of the distribution system when the pump station is operating at maximum flow.

4.5.3.6. When pressure in zone is controlled solely by a booster pumping station, a pressure relief valve is required to prevent excessive build up of pressure.

#### 4.5.4. Control Equipment

4.5.4.1. Controls shall provide automatic shutoff at 15 psig suction pressure.

4.5.4.2. Pumping units and necessary appurtenances for operational control must be carefully selected by the design engineer for performance, reliability, and efficiency.

4.5.4.3. Pumping stations are to be designed for automatic operation, requiring only periodic visits by maintenance personnel, usually once per week.

4.5.4.4. Controls are required for automatic start and stop of pumps, based on hydraulic pressures or flow rates as determined by the design of the station. Some stations may require "cushion tanks" to minimize pump cycling under low flow conditions. County typically uses hydropneumatic tanks as a control device.

4.5.4.5. Controls are necessary for the protection of equipment in the instances of pressure surges due to normal starting and stopping of pumps, or in the event of a power outage.

4.5.4.6. Pressure gauges for direct reading of line conditions shall be placed on both suction and discharge piping of each pump, and on the main discharge header piping after the last pump.

4.5.4.7. An electrical control center shall be provided in a convenient location within the building for switch gear, motor control units, and for flow recording equipment. Alarms shall be provided and be sent via telemetry to the Bureau of Water and Sewer operations center as the system operation warrants. Under no circumstance shall these types of pumping stations be below ground or in a confined space. See the telemetry paragraph for further information.

#### 4.5.5. Mechanical Piping and Appurtenances

4.5.5.1. Arrangement of piping and equipment within the station shall be made with adequate space for maintenance, repair, and removal or replacement of equipment as well as to safeguard personnel working in the station.

4.5.5.2. Removable grating made of aluminum or fiberglass shall be used for access around and over piping, etc. Valve stems shall be extended up to grating level or above as applicable.

4.5.5.3. Clearances and other design features shall conform to MOSHA standards.

4.5.5.4. The layout of main system piping within all pump stations shall be based on Class 150 standard flanged ductile iron pipe and fittings. Manifolds shall include flexible couplings for make-up and for expansion and contraction of the piping system.

4.5.5.5. Control and instrumentation piping shall be copper or stainless steel.

4.5.5.6. Butterfly valves shall be provided on the suction and discharge side of each pump to permit removal. Check valves shall be placed on the discharge side of each pump. Evaluate potential water hammer problems. Provide isolation valves to allow for repair of check valves.

4.5.5.7. Forced air ventilation is to be provided, designed with sufficient capacity to remove heat generated by pump motors and controls.

4.5.5.8. Floor slabs shall be sloped to provide for positive drainage to a sump pump for removal.

#### 4.5.6. Telemetry

4.5.6.1. Telemetry of critical status and conditions from the water pumping station to the New Design Water Treatment Plant is via 800 megahertz radio transmission.

4.5.6.2. Station control room or panel shall provide for housing of radio related components, including an antenna. Additionally, an interface panel where connections between individual sensor circuits and the radio components is required.

4.5.6.3. Typical conditions monitored include:

- |                     |                          |
|---------------------|--------------------------|
| •High Tank Level    | •Zone Flow Rate (analog) |
| •Zone Low Pressure  | •Tank Level (analog)     |
| •Normal Power       | •Low Tank Level          |
| •Auxiliary Power    | •Pump Failure            |
| •Building Intrusion | •Zone High Pressure      |

#### 4.5.7. Metering

4.5.7.1. Turbine, differential pressure or magnetic flow meters are required with a 30-day strip chart recorder. Recorders shall be compatible with an RS-232 port.

4.5.7.2. Meter accuracy must be 95 percent of the anticipated flow requirements.

4.5.7.3. The maximum pressure drop through a meter must not exceed 4 psi during fire flow conditions.

4.5.7.4. Sufficient straight runs of pipe will be needed prior to the water entering the meter in order to stabilize the flow. Each manufacturer of a particular meter has specific requirements and dimensions that are suggested to stabilize the flow. The designer must fully investigate these requirements and incorporate them into the design.

4.5.7.5. Some meters may be required to provide a 4-20 ma signal to the telemetry interface panel.

#### 4.6. SEWAGE PUMPING STATIONS

4.6.1. General: The engineer shall make special reference to the National Fire Protection Association manual NFPA 820 in the design of pumping station electrical control and ventilation systems.

4.6.1.1. Design features of the structure and mechanical equipment shall take into account the functional requirements of pumping, automation, maintenance, personnel safety, and noise and odor controls. Pumping units, design features, and mechanical appurtenances must be carefully selected by the design engineer for performance, reliability, and efficiency. Pumping stations may be the built-in-place or the prefabricated package types.

4.6.1.2. Backup power is required for all stations, except as otherwise provided herein.

4.6.1.3. Suitable masonry buildings are to be considered for enclosures for pump station controls and backup power supply systems. This shall be true of all size pump stations.

4.6.1.4. The maximum speed for synchronous motors driving small pumps 75 HP and less is 1,800 rpm. The maximum speed for synchronous motors driving larger pumps shall not exceed 1,200 rpm.

#### 4.6.2. Classifications of Pump Stations

4.6.2.1. Very Small Stations (Grinder) are less than 25 EDUs and less than 20 gpm. Duplex pumps are grinder pumps with a



discharge of 1.5 or 2-inch diameters. They can be package, prefabricated, or built-in-place. Twenty-four (24) hour wet well storage is to be supplied in lieu of back-up power. Control panels can be an outdoor pedestal-mount type. Fiberglass wet wells are permissible if buoyancy and structural concerns are addressed.

4.6.2.2. Small Stations (Grinder) are stations that pump between 20 and 80 gpm, inclusive. In duplex pump stations, only one pump is to be used to handle peak flows. Discharge piping is between two (2) and three (3) inches. These stations can provide for future growth if the pump case is available with a range of impeller and horsepower sizes. Prefabricated or built-in-place stations can be utilized. Controls can be located outside, as was the case with small stations, or in an appropriately sized building depending on reliability requirements. Flow meters may be required.

4.6.2.3. Medium Stations (Trash) are stations that pump between 80 and 560 gpm. Typically these stations are duplex, but can be triplex. These stations are expandable for future growth by replacing existing impellers or making provisions for a third pump. However, the motor size must be carefully evaluated before impellers are replaced, otherwise a motor overload could occur. Pumps shall handle 3-inch solids with a 4-inch discharge. The discharge size is critical for future expansions. Prefabricated stations can be used if the flow is less than 300 gpm, otherwise built-in-place stations must be used. Controls are to be located in an appropriately sized building. Splash baffles may be required on interior walls. A flow meter is required.

4.6.2.4. Large Stations (Trash) are stations that pump over 560 gpm. These stations must be of the wet well/dry well type. All underground structures must be type II concrete.

4.6.2.5. In the event a pump station was to overflow, the location of the overflow must be identified. The storage remaining before an overflow occurs in the wet well, at average daily flow, must be furnished on the drawings.

#### 4.6.3. Hydraulic Criteria

4.6.3.1. General: The pumping units shall be selected to satisfy both the initial and ultimate design hydraulic peak flows as described in Chapter 3, if feasible. If not feasible, then the pump capacity may be scaled down to accommodate the initial flow rate and an intermediate flow rate based on an approved interim state of development. Pumping units can be upgraded by means of impeller changes (and considering the existing motor

size), speed changes, or both. At least one standby pump shall be provided and shall be designed and equipped to be operational at all times. Pumps shall be of such capacity that with the largest unit out of service, the remaining pumps will deliver the peak flow.

#### 4.6.4. Force Mains

4.6.4.1. Force main sizes shall be determined by consideration of total friction head, size of the solids, maximum and minimum desirable velocities and by power requirements. For diameters of 3-inch and smaller, SDR-21, ASTM-2241 PVC is typically used with gasket joints. For diameters 4-inch and larger, DIP is used. Friction factors for PVC pipe are typically  $C = 140$  and for DIP,  $C = 120$ .

4.6.4.2. The minimum and maximum velocities are 2.25 feet per second (fps) and 8 fps, respectively. When minimum pumping rates will not satisfy velocity requirements, then pump capacities must be increased accordingly.

4.6.4.3. Force mains shall discharge into a manhole from a rising grade, where possible, at or near the invert of the effluent pipe. See the *Standard Details*.

4.6.4.4. Crown elevations that are higher than force main outlets shall be avoided. This keeps force main full at all times.

4.6.4.5. Blowoffs shall be provided at all line sumps and air release/vacuum valves provided at the peaks as required.

4.6.4.6. At certain critical stations, a tee and two resilient seat gate valves shall be placed on the force main in close proximity to the pump station to facilitate bypassing the pumping station with portable emergency pumps. This valved connection shall terminate near the ground surface in a vault with special couplings or threaded pipe as determined by the Bureau of Water and Sewer. The point of connection shall be conveniently located with respect to the outside wet well opening.

4.6.4.7. Manifold force mains require special hydraulic calculations with appropriate system curves, pump curves, etc. Manifold force mains shall be avoided in areas that are subject to future expansions and growth.

4.6.4.8. An insulated #8 AWG trace wire shall be furnished for all nonmetallic force mains.

4.6.4.9. Force main piping and fittings must be designed to withstand maximum surge pressures and water hammer.

4.6.4.10. For clearances and stream crossings see Chapters 2 and 3.

#### 4.6.5. Pumps

##### 4.6.5.1. Wet Well/Dry Well Type

4.6.5.1.1. Water seals shall be provided on all pumps where possible; otherwise, grease seals shall be used. Ceramic shaft sleeves of 400 Brinell hardness or greater, shall be provided in all cases.

4.6.5.1.2. Each pumping unit shall be fitted with stainless steel wear rings and bearings capable of a minimum 10,000 hours AFBMA-10 bearing life.

4.6.5.1.3. Each pump shall have an individual separate suction line from the wet well and shall have sufficient positive suction head measured from the low water level in the wet well. Pumps shall be capable of passing 3-inch diameter spheres, and pump suction and discharge opening shall be at least four inches in diameter. Each pump discharge volute casing and suction elbow shall be provided with an inspection and cleanout opening.

4.6.5.1.4. The minimum head for individual pumps must be identified to determine the maximum brake horsepower (motor size) required and the maximum flow at which the pump may operate satisfactorily.

4.6.5.1.5. A vibration performance specification for each pumping unit shall be achieved by means of proper balancing and structural supporting. At operating RPM, at no point on the pump drive motor, steady bearing support beam for intermediate shafting and the pump, shall the vibration velocity exceed 0.30 inches per second.

##### 4.6.5.2. Submersible

4.6.5.2.1. In the extension of the County sewerage system, occasionally there is a need for small sewage pumping stations to serve limited areas or small volumes of flow. Usually, this type of station is temporary and necessary only to provide an interim service until a gravity system can be extended or completed.

4.6.5.2.2. When the need is established for pumping stations to be installed with peak capacities less than 300 gallons per minute, the County may then consider the employment of prefabricated submersible duplex pumping units set in a below-ground, wet well structure. However, in the design of this type of pump station, the engineer shall eliminate problems associated with confined space entry problems by maintenance personnel.

4.6.5.2.3. The use of grinder pumps or ejector stations shall only be permitted when directed by County.

4.6.5.2.4. The minimum head for individual pumps must be identified to determine the maximum brake horsepower required and the maximum flow at which the pump may operate satisfactorily.

4.6.5.2.5. Submersible pumping stations shall incorporate, but not be limited to: no valves in wet well but enclosed in a separate vault with emergency pump around connection, hoist provisions for removing pumps, all alarms and mechanical requirements.

#### 4.6.6. Wet Well Design

4.6.6.1. The determination of the volume of the wet well is critical to the pump station design as its capacity effects the time the sewage will remain in the station and the frequency of operation of the pumps. The wet well receiving the incoming sewage shall be sized to provide a minimum pumping cycle of 10 minutes, alternating with the total time on and the total time off, using the following formula:

$$V = T * Q/4$$

where:

V = Volume in gallons of wet well between lead pump on and lead pump off levels

T = pumping cycle in minutes, for example, 10

Q = pumping rate of lead pump in gallons per minute

4.6.6.2. To reduce the occurrence of odor, the detention period for sewage in the wet well is not to exceed 30 minutes at the average flow rate for the initial, intermediate, and ultimate design years. This can be achieved by the operator making adjustments to the level controls.

4.6.6.3. If initial average flows are insufficient to actuate the pump within a 30-minute period, temporary removable appurtenances shall be placed in the wet well or the liquid level control points shall be lowered.

4.6.6.4. The differential between pump start and off levels shall not be less than two (2) feet. The wet well floor shall be sloped at 45 degrees to form a hopper. To establish net positive suction head (NPSH), the net volume of the wet well shall be measured from a level approximately one foot above the top of the pump volute.

4.6.6.5. Wet wells utilizing submersible pumps shall not provide ladders or manhole steps for access by maintenance personnel.

4.6.6.6. Underground structures shall be made of reinforced concrete. Wet well interior surfaces in particular, shall be coated with 40 mils of coal-tar epoxy. Access doors must be of aluminum and sized for safe removal of equipment.

4.6.6.7. When required by the Bureau of Water and Sewer, a bar screen basket shall be placed at the end of the influent sewer where it enters the wet well. Automatic bar cleaning equipment is not to be used. The bars of the bar screen shall be fabricated and placed in such a manner as to facilitate raking of debris into an auxiliary basket. Bars shall be one inch square with clear openings between them of  $2\frac{1}{2}$  inches. A hatch shall be provided at ground level over the wet well hopper to facilitate debris removal. An outrigger shall be provided to support a chain fall to lift the bar screen basket out of the wet well.

#### 4.6.7. Dry Wells

4.6.7.1. A separate sump pump shall be placed in the dry well to remove both seepage and leakage that shall be pumped to the wet well.

4.6.7.2. The floor of the dry well shall be sloped to the sump pump for positive drainage.

4.6.7.3. The sump pump discharge piping, as well as any mechanical or electrical conduits, shall pass through the separation wall of the wet well, well above the high water level of the wet well and shall be gas tight.

4.6.7.4. To enable the control of flooding in the dry well, plug valves will be placed on the suction piping and the valve stems will have extensions to allow access from the control room floor.

4.6.7.5. Pressure gauge taps, with pet cock fittings and pressure gauge, shall be placed on the suction and discharge lines of each pump as well as on the main discharge header after the last pump.

#### 4.6.8. Control Equipment

4.6.8.1. When a two pump system is designed, an automatic electric control shall be installed so that the lead pump alternates at each cycle.

4.6.8.2. To be compatible with telemetry, pump operation is to be controlled by an analog controller capable of a 4-20 ma electrical output. Output must be in proportion to the height of the liquid in the wet well. The level of sewage in the wet well is to be activated by an air bubbler system or pressure transducer. The liquid level sensor shall be designed and located as not to be influenced by turbulence from flows entering or leaving the wet well. A back-up high level alarm shall be furnished that utilizes a float switch.

4.6.8.3. A separate manual control shall be provided so that the pumps may be manually activated or shut down at the low level alarm.

4.6.8.4. Automatic alarms shall have individual circuit breakers.

4.6.8.5. Controls shall be placed above grade in a suitable building. Refer to previous discussions in this Chapter.

4.6.8.6. Alarms shall be provided and shall be sent via telemetry to the Bureau of Water and Sewer Operations Center control panel as the system operation warrants. A schematic of the telemetry system shall be shown on the plans.

4.6.8.7. All main pumps shall be provided with pilot lighting indicating "on" and "off" operating status, and lights shall be green and red, respectively, and be located at a central control panel. Indicator lights for the pumps shall be located on the outside of each starter cabinet.

4.6.8.8. An electrical control center shall be provided in a convenient location to house the switch gear, motor control units, telemetry, and flow recording equipment.

#### 4.6.9. Mechanical Piping and Appurtenances

4.6.9.1. Pump suction and discharge piping shall be ductile iron pipe with standard flanged joints. All flexible couplings or joints shall be suitably restrained.

4.6.9.2. Air or oil cushioned check valves shall be placed on each individual pump discharge line. Vertical ball check valves can be used in submersible stations.

4.6.9.3. Shutoff valves shall be placed on both the suction and discharge lines to facilitate the removal of each of the pumping units. For pipes up to 20 inches in diameter, plug valves are to be used for shutoff valves within the station.

4.6.9.4. Flexible couplings shall be selected to allow for proper expansion and contraction of the piping system.

4.6.9.5. Grating (cat walks) shall be provided in the pump room to facilitate access to all piping without climbing over pipes, equipment, etc.

4.6.9.6. Adequate lighting shall be provided both inside and outside all stations. Lighting in the wet well shall be explosion proof.

4.6.9.7. Heavy-duty, corrosion resistant and maintenance-free screens shall be placed outside over all louvers and vents.

#### 4.6.10. HVAC

4.6.10.1. Forced air ventilation shall be provided to both the wet well and dry well independent of each other. The wet well ventilation shall be of the forced air, positive pressure type with spark proof fan wheel and motor control units. The wet well vents shall not penetrate into the motor room or pump room. The system shall be sized to provide a minimum of 30 complete air changes per hour under manual control and with a time clock control, a minimum of two complete air changes per hour. Dry well ventilation rates shall be 10 and 4 respectively.

4.6.11. Telemetry: For each class remote telemetry unit (RTU) see the Appendix.

4.6.11.1. Telemetry of critical status and conditions from the water pumping station to the New Design Water Treatment Plant is via 800 megahertz radio transmission.

4.6.11.2. Station control room or panel shall provide for housing of radio related components, including an antenna. Additionally, an interface panel where connections between individual sensor circuits and the radio components is required.

4.6.11.3. Typical conditions monitored include:

- High Wet Well Level Alarm
- Wet Well Level (analog)
- Low Wet Well Level Alarm
- Normal Power
- Auxiliary Power
- Building Intrusion

#### 4.6.12. Metering

4.6.12.1. When required by the Bureau of Water and Sewer, a magnetic flow meter with a 30-day strip chart is to be provided. Recorder is to have a RS-232 port.

4.6.12.2. Meter accuracy is to be 95% of true flow.

4.6.12.3. Provide sufficient straight piping runs as required by meter.

4.6.12.4. Some meters may be required to provide 4-20 MA signal to the telemetry interface panel.

## CHAPTER 5. -- MISCELLANEOUS FACILITIES

### 5.1. GENERAL

5.1.1. Definition: The term "facility" refers to a water or sewer installation that involves electrical/mechanical equipment usually operated by automatic controls. Examples of facilities are pumping stations, treatment plants, water storage tanks, rechlorination stations, etc.

5.1.2. Design Process and Format: Design of facilities shall be as previously specified in Chapters 1, 2, 3 and 4. Complete design criteria, sectional views to scale, and schematic diagrams must be included on the plans.

#### 5.1.3. Water System Flow Calculations

##### 5.1.3.1. Well Supply

5.1.3.1.1. Minimum requirement is that when the well with the highest rated flowrate is out of service, combined pumping capacity of remaining wells must equal or exceed average daily flowrate (ADF) based on the number of EDUs times a peaking factor of 1.4.

5.1.3.1.2. Combined total pumping capacity of all wells must be greater than or equal to a factor of 2 times the ADF.

5.1.3.1.3. Additional well capacity above minimal requirements can be used to reduce storage volume requirements.

5.1.3.2. Water Storage Tanks: Usable tanks storage capacity, that is, gallons, must be the larger size as calculated in three different ways:

5.1.3.2.1. Provide 30 minutes of chlorine contact time at the maximum flowrate into the tank.

5.1.3.2.2. Minimum storage must exceed total of 1 days average domestic flow + fire storage + minimum of 4 hours of smallest pump run time + 1 foot of elevation difference between pump off level to HWL + 1 foot of elevation difference between HWL and tank overflow invert + dead storage.



5.1.3.2.3. Based on supply pumping capacities (gpm), storage must provide for four days of simulated summer heat wave demand when largest well is out of service, assuming no fire flows are required. That is: total usable storage must be equal to or exceed the difference between  $4 \times 1.5$  times the average daily domestic flow in gallons and  $4 \times$  the total gallons provided by the well supply when the largest well is out of service.

NOTE: UNWRITTEN PORTIONS TO BE DEVELOPED.

## CHAPTER 6. — TREATMENT PLANTS

### 6.1. GENERAL

#### 6.1.1. Definitions:

6.1.1.1. Design Process and Format: Design of facilities shall be as previously specified in Chapters 1, 2, 3 and 4. Complete design criteria, sectional views to scale, and schematic diagrams must be included on the plans. Additionally, process schematic and hydraulic profile must be included on the plans.

6.1.1.2. Water Flow Calculations: Treatment capacity of the water plant must be equal to 1.4 times the ADF based on EDUs. This provides for lawn sprinkling and other peak usage during summer conditions.

#### 6.1.2. Sewer Flow Calculations:

#### 6.1.3. Auxiliary Electrical Power:

NOTE: UNWRITTEN PORTIONS TO BE DEVELOPED.

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APPENDIX A  
(Drawing Tables and General Notes)

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DPW WATER AND SEWER SERVICES TO MUNICIPALITIES

Town/City	W/S Design Review	W/S Inspection	W/S Service Connections	County System
Brunswick	No	No	No	No <sup>1</sup>
Burkittsville	No	No	No	No
Emmitsburg	No	No	No	No
Frederick	Sewer <sup>2</sup>	Sewer <sup>2</sup>	Sewer <sup>2</sup>	Sewer <sup>2</sup>
Middletown	Yes	Yes	Yes	No
Mt. Airy	No	No	No	No
Myersville	Yes	Yes	Yes	No
New Market	Sewer <sup>3</sup>	Sewer <sup>3</sup>	Sewer <sup>3</sup>	Sewer <sup>3</sup>
Rosemont	No	No	No	No
Thurmont	No	No	No	No
Walkersville	Sewer	Yes	Water/Sewer	Sewer
Woodsboro	No	No	No	No

Notes:

- 1 The County owns and maintains a low pressure sewer system (LPSS) in Knoxville/New Addition that utilizes the City of Brunswick's sewer treatment plant.
- 2 The County owns and maintains sewer lines to the north of the City that flow to the Monocacy Interceptor and into the Ceresville Pumping Station. A flow meter at the City's Monocacy WTP delineates the limit of collection system ownership.
- 3 The Town of New Market currently has no public water facilities. The County has public water systems in the subdivisions of New Market West and Woodspring, which are outside the Town limits.

The cover sheet for all plans involving the construction of water and sewer facilities shall have as a minimum the following general notes:

#### GENERAL NOTES

1. All water and sewer construction shall be in accordance with the *Frederick County General Conditions and Standard Specifications and Details for Water Mains, Sanitary Sewer and Related Structures, Special Provisions and Amendments thereto.*
2. The contractor shall not tap or penetrate existing water and/or sewer mains without approval from Frederick County.
3. The contractor shall not operate valves on existing County-owned water mains.
4. The contractor is responsible to avoid the spillage of raw sewage. The contractor shall furnish necessary equipment (sewer plugging, pumping, containment, etc.) to prevent said spillage.
5. Excavation within a State road right-of-way shall be performed in accordance with the provisions in the permit issued by the Maryland State Highway Administration (SHA).
6. Excavation within a County road right-of-way for the purpose of the installation of utilities, storm drains, etc. shall be performed in accordance with the provisions in the permit issued by the Frederick County Division of Highway Operations.
7. Existing utilities are shown from best available records. The contractor shall test pit in the area of known utilities to verify size, elevation, location and type prior to performing any work. Any utility, whether shown or not, that is damaged by the contractor shall be repaired immediately at no expense to the owner. SHOULD THE CONTRACTOR DISCOVER DISCREPANCIES BETWEEN THE PLANS AND FIELD CONDITIONS, THE OWNER IS TO BE NOTIFIED IMMEDIATELY. SHOULD THE CONTRACTOR MAKE FIELD CORRECTIONS OR ADJUSTMENTS WITHOUT THE AUTHORIZATION OF THE OWNER, THEN THE CONTRACTOR ASSUMES THE RESPONSIBILITY FOR SAID CORRECTIONS OR ADJUSTMENTS.
8. Any necessary adjustments to existing manholes, valve boxes, etc., are to be done so by the contractor. The contractor is responsible for removing and replacing any existing fences, driveways, signs, drainage pipes, mailboxes, shrubs, trees, etc. damaged or removed during construction. All disturbed areas shall be returned to their original condition or better.
9. The contractor shall notify Miss Utility (1-800-257-7777) 72 hours prior to start of construction.
10. The contractor shall be responsible for keeping silt and debris out of the storm drainage system for the duration of the contract.
11. The contractor shall maintain access to all property owners at all times. The contractor, with owner approval, will coordinate with property owners if access must be interrupted for short time periods.

# CONTRACT QUANTITIES TABLE

The cover sheet shall have a quantities table for all projects that involve the construction of water and/or sewer lines. The table provides information that is useful to various County engineering, construction management, operations, and administration personnel. The table is not intended for use by contractors preparing estimates, bids, etc. and shall be duly noted by the engineer.

The following table shall furnish the minimum information in the format similar to that provided below:

## QUANTITIES

ITEM	ESTIMATED	UNITS	AS-BUILT	SUPPLIER/MATERIAL
			(To be completed by the County)	
8" SEWER		LF		
6" SEWER		LF		
MANHOLES:				
• STD 48"		EA		
• WATERTIGHT 48"		EA		
DOGHOUSE MH's 48"		EA		
VENTS		EA		
DROP MANHOLES:				
• TYPE E		EA		
• TYPE F		EA		
SHC TYPE A,B				
• SINGLE		EA		
• DOUBLE		EA		
SHC TYPE C,D				
• SINGLE		EA		
• DOUBLE		EA		
LAMPHOLE		EA		
CASING PIPE				
"          "		LF		
8" WATER		LF		
6" WATER		LF		
8" VALVE		EA		
6" VALVE		EA		
STD HYDRANT		EA		
DEWATERING HYDRANT		EA		
CAP & BLOWOFF		EA		
AUTO AIR-RELEASE				
VALVE		EA		
WHC				
• 3/4"		EA		
• 1"		EA		
• 1-1/2"		EA		
TAPPING SLEEVE &				
VALVE		EA		
CASING PIPE				
"          "		LF		

WATER AND SEWER SERVICE CONNECTION  
QUANTITIES TABLE

The cover sheet shall have a quantities table for all projects that involve the construction of water and/or sewer service connection. The following table shall furnish the minimum information in the format provided below.

Service Connections		[County Use Only]	
Type	Estimated	As-Built	Remarks
WSC New			
WSC Abandon			
WSC Replace			
DWSC New			
DWSC Abandon			
DWSC Replace			
SSC New			
SSC Abandon			
SSC Replace			
DSSC New			
DSSC Abandon			
DSSC Replace			



# WATER SERVICE LOCATION TABLE

An example of the table that shall appear in the design drawings follows:

Water Service Connections

Lot #	Street Name	Single/Double	Meter Dist. fr. Prop. corners (l/r)	Meter Dist. from Main	Dia	Station of Corporation Valve
1	Elm Street	S	25'L/30'R	18'	3/4"	1+50
2-3	Elm Street	D	Corner	16'	1"	2+73

Water Service Connections

Lot #	Street Name	Single/Double	Meter Dist. fr. Prop. corners (l/r)	Meter Dist. from Main	Dia	Station of Corporate Valve

# SEWER SERVICE LOCATION TABLE

An example of the table that shall appear in the design drawings is as follows:

Sewer Service Connections

Lot #	Street Name	Lowest Floor Elevation	Cleanout Elev.	As-Built Information					
				Station	U/S MH	D/S MH	Length	Depth	Remarks
1	Willow	414.12	412.50	2+50					
*	Way *	*	*	*					

Note: The designer shall fill out all requested information indicated with an asterisk (\*). The remaining as-built information is to be completed by the County with the exception of the column labeled "Station".

Sewer Service Connections

Lot #	Street Name	Lowest Floor Elevation	Cleanout Elev.	As-Built Information					
				Station	U/S MH	D/S MH	Length	Depth	Remarks
*	*	*	*	*					

## SIGNATURE BLOCKS

Standard signature block for County water and sewer projects:

FREDERICK COUNTY DEPARTMENT OF PUBLIC WORKS APPROVAL FOR WATER AND SANITARY SEWER ONLY	
APPROVED: _____	_____
DIRECTOR	DATE
APPROVED: _____	_____
CHIEF ENGINEER	DATE
<p>Approval is valid for one (1) year after the last date shown above. The project must be under contract before the said date to be considered valid. Otherwise, resubmittal of plans must be made to the Bureau of Water and Sewer for reapproval. Review fees necessary for reapproval shall accompany the said resubmittal. Fees cannot be waived.</p>	

Standard signature block for County sewer only. Typically, this signature block applies to projects within Walkersville, Knoxville/New Addition and parts of the City of Frederick:

FREDERICK COUNTY DEPARTMENT OF PUBLIC WORKS APPROVAL FOR SANITARY SEWER ONLY	
APPROVED: _____	_____
DIRECTOR	DATE
APPROVED: _____	_____
CHIEF ENGINEER	DATE
<p>Approval is valid for one (1) year after the last date shown above. The project must be under contract before the said date to be considered valid. Otherwise, resubmittal of plans must be made to the Bureau of Water and Sewer for reapproval. Review fees necessary for reapproval shall accompany the said resubmittal. Fees cannot be waived.</p>	

APPENDIX B  
(Checklists)

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FREDERICK COUNTY DEPARTMENT OF PUBLIC WORKS  
BUREAU OF WATER AND SEWER

PROJECT NAME: \_\_\_\_\_  
FREDERICK COUNTY CONTRACT NO.: \_\_\_\_\_  
CONSULTING FIRM: \_\_\_\_\_  
PROJECT MANAGER/DESIGN ENGINEER: \_\_\_\_\_  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
STATUS: (Initials = completed, N/A = not applicable, \* = see attached  
          explanation)

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PRELIMINARY PLANS

SUBMITTER		COUNTY REVIEW
	1. General	
_____	1.1 Title	_____
_____	1.2 Vicinity Map	_____
_____	1.3 Show the current water and sewer classification of the property	_____
_____	1.4 Engineer's Name, etc.	_____
_____	1.5 Developer's Name, etc.	_____
_____	1.6 Smallest scale: 1"=100'.	_____
_____	1.7 Project Scope, Number of Lots, townhouses, rentals, Equivalent Dwelling Units, etc., if known.	_____
_____	1.8 Existing and future utilities and easements shown	_____
_____	1.9 Proposed W/S utilities and easements shown	_____
_____	1.10 Existing, proposed, future street and pavement layouts shown	_____
_____	1.11 Indicate W/S easement encroachments by storm drains, etc.	_____
_____	1.12 Indicate W/S encroachment in others' easements, e.g., SHA right-of-way	_____
_____	1.13 When other than FrCo owned or maintained by W/S, identify as private or identify municipality, etc.	_____

_____	1.14	Indicate when FrCo owned W/S in private (non-dedicated) streets	_____
_____	1.15	Indicate proposed facilities such as swimming pools, clubhouses, etc.	_____
_____	2.	Water	_____
_____	2.1	Pipe sizes indicated	_____
_____	2.2	Adjoining properties have access to the water main, either by an easement or by the water main being extended to the property line	_____
_____	2.3	Easements shown (Minimum Size = 30 feet) with water offset 10 feet to one side	_____
_____	2.4	Existing homes with 200 feet of a new distribution line must have access to the water main	_____
_____	2.5	Fire hydrants spaced and shown	_____
_____	2.6	Water mains are looped	_____
_____	2.7	Pressure zones delineated and labelled, if known	_____
_____	2.8	Indicate possible booster stations, if known	_____
_____	2.9	Indicate special metering, fire services, if known	_____
_____	2.10	Indicate Cross Connection Control provisions	_____
_____	3.	Sewer	_____
_____	3.1	Pipe sizes indicated	_____
_____	3.2	Adjoining properties have access to the sewer main, either by an easement or by a stub extended to the property line	_____
_____	3.3	Easements shown (Minimum Size = 30 feet) with sewer offset 10 feet to one side	_____
_____	3.4	Existing homes within 200 feet of a new sewer main must have access to the sewer main	_____
_____	3.5	Hydraulic capacity of existing mains and pump stations should be checked	_____

- |       |      |  |       |
|-------|------|--|-------|
| _____ | 3.6  | Show flow direction arrows between each manhole  | _____ |
| _____ | 3.7  | SSCs shown, approximate locations  | _____ |
| _____ | 3.8  | Note any service restrictions, e.g., first floor only                                  | _____ |
| _____ | 3.9  | Note any low service connections subject to overflow if sewer main surcharges slightly | _____ |
| _____ | 3.10 | Number manholes from lowest invert to highest invert                                   | _____ |
| _____ | 3.11 | Indicate pretreatment devices, such as grease traps, etc.                              | _____ |

Additional Comments:

**FREDERICK COUNTY DEPARTMENT OF PUBLIC WORKS  
BUREAU OF WATER AND SEWER**

PROJECT NAME: \_\_\_\_\_  
FREDERICK COUNTY CONTRACT NO.: \_\_\_\_\_  
CONSULTING FIRM: \_\_\_\_\_  
PROJECT MANAGER/DESIGN ENGINEER: \_\_\_\_\_  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
STATUS: (Initials = completed, N/A = not applicable, \* = see attached  
explanation)

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**SITE IMPROVEMENT PLANS**

SUBMITTER		COUNTY REVIEW
	1. General	
_____	1.1 Title	_____
_____	1.2 Vicinity Map	_____
_____	1.3 Engineer's Name, etc.	_____
_____	1.4 Developer's Name, etc.	_____
_____	1.5 Project scope (No. of equivalent dwelling units, total square feet of office space, etc.) in tabular form	_____
_____	1.6 Existing, proposed and future utilities shown	_____
_____	1.7 When other than FrCo owned water and sewer, identify as private, municipal, etc.	_____
_____	1.8 Indicate if water and sewer is FrCo owned in private or non-dedicated streets	_____
_____	1.9 Show proposed facilities such as swimming pools, clubhouses, etc.	_____
	2. Water	
_____	2.1 Water service provided to all lots, buildings and outparcels	_____
_____	2.2 Water meter vault shown to scale	_____
_____	2.3 Siamese connections located	_____
_____	2.4 Avoid the use of private fire hydrants	_____



- |       |     |  |       |
|-------|-----|--|-------|
| _____ | 2.5 | Fire hydrants spaced and shown   | _____ |
| _____ | 2.6 | Cross connection control provisions are indicated  | _____ |
| _____ | 2.7 | Site improvement plans included  | _____ |
|       | 3.  | Sewer  |       |
| _____ | 3.1 | Obtain pretreatment permit or waiver   | _____ |
| _____ | 3.2 | Monitoring manhole shown for all commercial, industrial, business, etc. properties. These manholes are required regardless of a pretreatment permit or waiver. | _____ |
| _____ | 3.3 | Site improvement plans included  | _____ |
|       | 4.  | Miscellaneous  |       |
| _____ | 4.1 | If the site plan includes construction design information, the Improvement Plan checklist must be submitted.   | _____ |

Additional Comments:

FREDERICK COUNTY DEPARTMENT OF PUBLIC WORKS  
BUREAU OF WATER AND SEWER

PROJECT NAME: \_\_\_\_\_  
FREDERICK COUNTY CONTRACT NO.: \_\_\_\_\_  
CONSULTING FIRM: \_\_\_\_\_  
PROJECT MANAGER/DESIGN ENGINEER: \_\_\_\_\_  
CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
STATUS: (Initials = completed, N/A = not applicable, \* = see attached  
explanation)

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IMPROVEMENT PLANS

SUBMITTER		COUNTY REVIEW
	1. Cover Sheet	
_____	1.1 Title, include water/sewer project type	_____
_____	1.2 Contract Number	_____
_____	1.3 Vicinity Map (1" = 600'), framed with three grid ticks	_____
_____	1.4 Location Map, when needed (1" = 2,000')	_____
_____	1.5 Engineer's Name, etc.	_____
_____	1.6 Developer's Name, etc.	_____
_____	1.7 Number of lots, EDUs, townhouses, etc.	_____
_____	1.8 Standard General Notes	_____
_____	1.9 Sheet Index Schedule (when 3 or more total sheets)	_____
_____	1.10 Cover Sheet (or second sheet) Sheet index map, showing streets, W/S mains and appurtenances (required when 4 or more plan sheets)	_____
	2. All Sheets	
_____	2.1 Title	_____
_____	2.2 DPW Signature Block	_____
_____	2.3 PE Seal and Signature	_____
_____	2.4 Scales: plan 1" = 50', profile 1" = 5', (some townhouse plans are at 1" = 30') indicated	_____

2.5 Plans submitted on a maximum size sheet of 24" x 36"

3. General

3.1 Note: Water and sewer construction projects within existing platted areas within the Lake Linganore service area are allowed certain variances from FrCo W/S standards. These variances will be detailed in a subsequent amendment to the Design Guidelines.

3.2 Proposed W/S utilities and easements shown with bold lines and existing/future shown with dashed lines

3.3 Pipe main sizes indicated in plan and profile view as 8"W, 12"W or 8"S, 12"S, etc. Service connection pipe size indicated as 1"WSC or 6"SSC, etc. in plan view.

3.4 Existing and future W/S utilities and easements shown with contract numbers

3.5 Existing non-W/S utilities, e.g., storm drain, gas, easements, etc. shown in plan and profile views with sizes, inverts and appropriate clearances

3.6 Lot and parcel numbers indicated

3.7 All project owner and adjoining property owners indicated

3.8 Existing, proposed, future street and pavement layouts shown in both plan and profile views.

3.9 Existing buildings, structures, etc. shown and identified

3.10 Proposed buildings, structures, etc. shown at approximate locations and identified

3.10 Ground floor elevations for buildings indicated

3.11 Existing, future, and proposed easements, right-of-ways, roads, and driveways shown with width dimensions. State roads identified by Route No. and SHA plat number

- \_\_\_\_\_ 3.12 W/S service connections, i.e., WSCs, SSCs, shown to right of way line or easement line \_\_\_\_\_
- \_\_\_\_\_ 3.13 Contractors work limits and access road clearly identified \_\_\_\_\_
- \_\_\_\_\_ 3.14 Type of pipe material, or special class piping indicated in General Notes or on profile view \_\_\_\_\_
- \_\_\_\_\_ 3.15 North arrow, all plan views \_\_\_\_\_
- \_\_\_\_\_ 3.16 Elevation benchmarks, at least one on every plan sheet \_\_\_\_\_
- \_\_\_\_\_ 3.17 Standard Detail Number indicated in plan and profile to select among options or to flag rarely used details \_\_\_\_\_
- \_\_\_\_\_ 3.18 Plan and profile views titled with street name and correspond when viewed from right to left \_\_\_\_\_
- \_\_\_\_\_ 3.19 Plan and profile views shown for W/S piping that connects building to W/S connections required (site plans only) \_\_\_\_\_
- \_\_\_\_\_ 3.20 Indicate W/S easement encroachments by storm drains, etc. \_\_\_\_\_
- \_\_\_\_\_ 3.21 Contract Quantities Table, Water & Sewer Service Connection Table, Water Service Location Table, and Sewer Service Location Table shown and filled out. See sample tables in Appendix of Guidelines. \_\_\_\_\_
- \_\_\_\_\_ 3.22 Three State grid ticks shown, each plan sheet \_\_\_\_\_
- \_\_\_\_\_ 3.23 Ditches and swales shown with spot elevations, where they intersect with W/S lines \_\_\_\_\_
- \_\_\_\_\_ 3.24 100-year Floodplain and any wetlands indicated in both plan and profile views \_\_\_\_\_
- \_\_\_\_\_ 3.25 Special instructions for tapping or abandoning existing mains or for water meter removal \_\_\_\_\_
- \_\_\_\_\_ 3.26 Special instructions for terminating pipes with caps, etc. \_\_\_\_\_

- \_\_\_\_\_ 3.27 Where continuity of view is interrupted,  
indicate sheet number where view continues \_\_\_\_\_
- \_\_\_\_\_ 3.28 When other than FrCo owned or maintained  
by W/S, identify as private or municipality,  
etc. \_\_\_\_\_
- \_\_\_\_\_ 3.29 Indicate when FrCo owned W/S in private  
(non-dedicated) streets \_\_\_\_\_
- \_\_\_\_\_ 3.30 Pipe materials checked for proper strength  
due to internal pressures, external loads  
or laying conditions \_\_\_\_\_
- \_\_\_\_\_ 3.31 Indicate areas requiring special subgrade  
preparation, fill or compaction \_\_\_\_\_
- \_\_\_\_\_ 3.32 Subsurface or soil boring information,  
when required \_\_\_\_\_

4. Water

4.1 Water Plan View

- \_\_\_\_\_ a. Generally complies with preliminary  
and site plan; list major changes. \_\_\_\_\_
- \_\_\_\_\_ b. Pipe line sizes indicated (minimum  
4 inch) \_\_\_\_\_
- \_\_\_\_\_ c. Water pressure zones indicated \_\_\_\_\_
- \_\_\_\_\_ d. All valves, tees, bends, etc. are  
shown with a symbol and called out  
as to type and size \_\_\_\_\_
- \_\_\_\_\_ e. All relevant features shown within  
a minimum 100 foot radius of any  
proposed work \_\_\_\_\_
- \_\_\_\_\_ f. Three valves at each tee, four valves  
at each cross \_\_\_\_\_
- \_\_\_\_\_ g. Water valve spacing \_\_\_\_\_
- \_\_\_\_\_ h. Easements and right of way width sizes  
shown (minimum easement width 30 feet) \_\_\_\_\_
- \_\_\_\_\_ i. Fire hydrant and valve spacing adequate \_\_\_\_\_
- \_\_\_\_\_ j. Meter shown (over 3-inch, show vault  
and bypass piping) \_\_\_\_\_
- \_\_\_\_\_ k. Service provided to all existing or  
proposed lots, buildings and parcels \_\_\_\_\_

- \_\_\_\_\_ 1. WSCs shown from main to meter symbol \_\_\_\_\_  
at property line
- \_\_\_\_\_ m. Indicate water service connection (WSC) \_\_\_\_\_  
sizes as typical on a view or specify  
in the notes.
- \_\_\_\_\_ n. Consider all lots within 200 feet of \_\_\_\_\_  
main for access to the main
- \_\_\_\_\_ o. Method of construction labeled for road \_\_\_\_\_  
and utility crossings; submit letter from  
authority approving method.
- \_\_\_\_\_ p. Stationing shown at desired intervals \_\_\_\_\_
- \_\_\_\_\_ q. Blow offs at all dead ends \_\_\_\_\_
- \_\_\_\_\_ r. Air release valves at all high points \_\_\_\_\_  
when no service connections near
- \_\_\_\_\_ s. Dewatering hydrants (or blow offs) at \_\_\_\_\_  
all low points
- \_\_\_\_\_ t. Restraints used instead of buttresses \_\_\_\_\_  
for unstable soil conditions
- \_\_\_\_\_ u. Restraints used on main proximate to \_\_\_\_\_  
terminal end of main
- \_\_\_\_\_ v. Pressure regulator installed when \_\_\_\_\_  
water pressure exceeds allowable  
pressure to property
- \_\_\_\_\_ w. Check for large diameter service \_\_\_\_\_  
piping and special metering needed  
for fire services or for high elevation  
properties
- \_\_\_\_\_ x. Check for special cross connection \_\_\_\_\_  
control provisions
- \_\_\_\_\_ y. Check for any high pressure pipe or \_\_\_\_\_  
fittings required
- \_\_\_\_\_ z. Radius of curvature indicated for \_\_\_\_\_  
main deflection
- \_\_\_\_\_ aa. Show existing and proposed topo/grading \_\_\_\_\_

\_\_\_\_\_ 4.2 Water Profile View \_\_\_\_\_

- \_\_\_\_\_ a. Existing and proposed grade indicated \_\_\_\_\_

- \_\_\_\_\_ b. Minimum depth for DIP pipe is 3.5 feet \_\_\_\_\_
- \_\_\_\_\_ c. All valves, tees, bends, fire hydrants \_\_\_\_\_  
etc. are shown with a symbol and called  
out with size, type and station. Valves  
immediately adjacent to tees do not need  
stations
- \_\_\_\_\_ d. Vertical position of main dimensioned \_\_\_\_\_  
to invert of pipe
- \_\_\_\_\_ e. WSCs shown and labelled (stationing \_\_\_\_\_  
not required)
- \_\_\_\_\_ f. All water main crossings with other \_\_\_\_\_  
utilities are properly shown and called  
out with minimum clearance dimensioned;  
water main may need structural support
- \_\_\_\_\_ g. Minimum 1-foot clearance allowed \_\_\_\_\_  
between water main and any existing or  
proposed sanitary sewers, storm drains,  
other, etc.
- \_\_\_\_\_ h. Water main under sewer, then encase \_\_\_\_\_  
sewer in concrete if lack sufficient  
clearance
- \_\_\_\_\_ i. Pipe deflections within allowed limits \_\_\_\_\_  
of Standard Detail
- \_\_\_\_\_ j. At stream crossings the water main \_\_\_\_\_  
protected as required by FrCo and  
water course protected according to  
state agencies
- \_\_\_\_\_ k. Provide concrete anchors on slopes \_\_\_\_\_  
greater than 20%. See *Standard Details*.
- \_\_\_\_\_ l. Areas of structural fill cross-hatched \_\_\_\_\_  
and labeled

## 5. Sewer

### 5.1 Sewer Plan View

- \_\_\_\_\_ a. Generally complies with preliminary \_\_\_\_\_  
and site plan; list major changes.
- \_\_\_\_\_ b. Pipe line sizes indicated \_\_\_\_\_
- \_\_\_\_\_ c. Sewer treatment plant service area \_\_\_\_\_  
indicated

- d. Manholes shown and numbers given.  
Numbering starts at lowest invert and  
progresses to highest invert manhole.
- e. All relevant features shown within a  
minimum 100 foot radius of any proposed  
work
- f. Flow direction arrows shown between  
each manhole
- g. Lines into and out of manholes are at  
an angle of 90 degrees or greater
- h. Manholes located in streets or  
accessible with vehicle
- i. Manhole spacing
- j. Manholes in flood plains have  
watertight lids ("WT")
- k. Easements and right of way width  
sizes shown (minimum easement width  
30 feet)
- l. Service provided to all existing or  
proposed lots, buildings and parcels.
- m. Indicate SSC size as typical on a view  
or specify in the notes.
- n. SSCs shown at acceptable locations
- o. SSCs shown  
perpendicular to mainline
- p. Consider all lots within 200 feet of  
main for access to the main
- q. Method of construction labeled for road  
and utility crossings; submit letter from  
authority approving method.
- r. Sewers cannot be within 50 feet of an  
existing or proposed well without special  
design to protect well
- s. Pipe connections to manhole cannot be  
closer than 1 foot
- t. No more than 2 service connections to  
one manhole, if terminal manhole 3  
allowed if at approximate 90 degrees



- \_\_\_\_\_ u. Stubs shown along with length and  
percent of grade \_\_\_\_\_
- \_\_\_\_\_ v. Monitoring manholes to all commercial  
properties \_\_\_\_\_
- \_\_\_\_\_ w. On site grease trap with make and  
model, as required \_\_\_\_\_
- \_\_\_\_\_ x. Note any low service connections  
subject to overflow if sewer main  
surcharges slightly \_\_\_\_\_
- \_\_\_\_\_ y. Show existing and proposed topo/grading \_\_\_\_\_

## 5.2 Sewer Profile View

- \_\_\_\_\_ a. Existing and proposed grade shown \_\_\_\_\_
- \_\_\_\_\_ b. Minimum depth for PVC pipe is 3 feet \_\_\_\_\_
- \_\_\_\_\_ c. Manholes, service cleanouts shown  
with symbol \_\_\_\_\_
- \_\_\_\_\_ d. Line sizes indicated along with  
percent of slope \_\_\_\_\_
- \_\_\_\_\_ e. Minimum slopes: 8"-0.40%; 10"-0.28%;  
12"-0.22% \_\_\_\_\_
- \_\_\_\_\_ f. Manhole numbers shown, with "WT",  
if applicable \_\_\_\_\_
- \_\_\_\_\_ g. Rim elevations shown \_\_\_\_\_
- \_\_\_\_\_ h. Minimum invert drop through manholes  
is 0.1 feet and maximum drop is 0.5  
feet. Use drop manhole when needed. \_\_\_\_\_
- \_\_\_\_\_ i. Distances between manhole centerlines  
shown with stationing, starting from  
low invert to high invert \_\_\_\_\_
- \_\_\_\_\_ j. Stationing shown starting at 0+00 for  
the centerline of downstream manhole  
and ending at next upstream manhole \_\_\_\_\_
- \_\_\_\_\_ k. All connecting pipes to manhole shown  
with diameters and in/out invert  
elevations indicated together with  
compass direction (center of manhole as  
center of compass) \_\_\_\_\_
- \_\_\_\_\_ l. Drop manholes shown as such and  
labeled type "E" or "F" \_\_\_\_\_

- m. Invert elevations coincide when two views of manhole
- n. Stations and symbols indicated for service connections
- o. Cleanout invert elevations of SSCs at property line indicated; minimum cleanout elevation allowed is computed by taking main invert + main pipe diameter +  $0.02 * \text{horizontal distance to cleanout}$
- p. Minimum grade for 6-inch service connection = 2.00%. Maximum grade=5%. See *Standard Details* and specs.
- q. Indicate sewer drop service connections (SDSC) to raise cleanout invert at property line to less than 8.5 feet or to avoid connection pipe slopes greater than 5%
- r. Inverts of service connections to manhole must be 0.1 feet above outflow invert unless an inside manhole drop connection is used.
- s. All sewer main crossings with other utilities are properly shown and called out with minimum clearance dimensioned; sewer main may need structural support
- t. Minimum 1-foot clearance allowed between sewer main and any existing or proposed sanitary sewers, storm drains, other, etc.
- u. Water main under sewer, then encase sewer in concrete if lack sufficient clearance
- v. At stream crossings the sewer main protected as required by FrCo and water course protected according to state agencies
- w. Manholes in unimproved areas constructed so that rim elevation is 1 foot above finished grade
- x. Intersecting sewer mains at manholes where mains are of different diameters, have matching top of pipe bore elevations

\_\_\_\_\_ y. Provide concrete anchors on slopes  
greater than 20%. See *Standard Details*. \_\_\_\_\_

\_\_\_\_\_ z. Cleanouts, when on-site, must be  
spaced a maximum of 75 feet for  
4-inch PVC and 100 feet for 6-inch PVC  
or larger. Show on-site pipe sizes,  
materials, cleanout inverts, etc. \_\_\_\_\_

\_\_\_\_\_ aa. Areas of structural fill cross-hatched  
and labelled \_\_\_\_\_

6. Original/Sepias Submission for Signatures

\_\_\_\_\_ 6.1 Provide a summary list of the easement  
documents \_\_\_\_\_

\_\_\_\_\_ 6.2 Have all offsite easments been recorded  
and on-site easements submitted \_\_\_\_\_

\_\_\_\_\_ 6.3 All fee simple properties deeded to FCBCC  
and recorded \_\_\_\_\_

Additional Comments:

APPENDIX C  
(Design Tables, Curves, Forms, etc.)

TABLE OF CONTENTS

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Palmer-Bolus Flow Charts .....	TO BE DEVELOPED

# WATER STORAGE REQUIREMENTS

Population	Required Fire Flow (gpm)	Duration (hours)	Fire Flow Storage (gallons)	Total Storage (gallons)
≤1,000	1,500	4	360,000	432,000
1,500	1,500	5	450,000	540,000
2,000	1,500	6	540,000	648,000
3,000	1,750	7	735,000	882,000
4,000	2,000	8	960,000	1,152,000
5,000	2,250	9	1,215,000	1,458,000
6,000	2,500	10	1,500,000	1,800,000
10,000	3,000	10	1,800,000	2,160,000
13,000	3,500	10	2,100,000	2,520,000
17,000	4,000	10	2,400,000	2,880,000
22,000	4,500	10	2,700,000	3,240,000
27,000	5,000	10	3,000,000	3,600,000
33,000	5,500	10	3,300,000	3,960,000
40,000	6,000	10	3,600,000	4,320,000
55,000	7,000	10	4,200,000	5,040,000
75,000	8,000	10	4,800,000	5,760,000
95,000	9,000	10	5,400,000	6,480,000
120,000	10,000	10	6,000,000	7,200,000
150,000	11,000	10	6,600,000	7,920,000
200,000	12,000	10	7,200,000	8,640,000

## Notes:

1. Fire Flow =  $1020\sqrt{P}$  (1 - 0.01 $\sqrt{P}$ ), where P = population in thousands
2. ISO computed fire flow requirements should be used to determine storage requirements. Typically, one-third to one-half of the maximum day water usable should be provided in storage.

## FIRE HYDRANT DESIGN FLOW RATES

USE	FLOW RATE (gpm)
Residential (one and two-family)	1,000
Residential (multi-family)	1,250
Commercial	1,500
Industrial	1,500
Educational/Institutional	1,500

### Notes:

1. Flow rates are to be accommodated with a minimum pressure of 20 psi in the main.
2. Fire flow rate are to be combined with maximum daily rates of flow in the distribution network
3. The storage tanks in the system shall be considered at their minimum elevation when determining the fire flow residual pressure.
4. These flow rates are to be used in the design of public water mains, whether developer or County funded. The use of a property may require a higher flow rate that are to be accommodated by on-site storage.

# DEPTH OF COVER AND MANNING'S "n"

Type of Pipe	Min. Structural Depth of Cover (feet)	Manning's "n"
PVC SDR-35	3.5	0.009
Ductile Iron	2.0	0.012
Reinforced Concrete	3.0	0.013

## FLOW FACTORS

<u>Type of Development</u>	<u>(FF)</u>			
Dwelling Unit, detached	# Units	x	350	= gpd
Townhouses	# Units	x	300	= gpd
Apartments, multi-family	# Units	x	300	= gpd
Apartments, elderly	# Units	x	200	= gpd
Mobile Homes	# Units	x	175	= gpd
Office Buildings	Gross Sq. Ft.	x	0.20	= gpd
Medical Office Buildings	Gross Sq. Ft.	x	0.175	= gpd
Warehouses	Gross Sq. Ft.	x	0.021	= gpd
Retail Stores	Gross Sq. Ft.	x	0.048	= gpd
Supermarkets	Gross Sq. Ft.	x	0.20	= gpd
Drug Stores	Gross Sq. Ft.	x	0.13	= gpd
Beauty Salons	Gross Sq. Ft.	x	0.35	= gpd
Department Store with Lunch Counter	Gross Sq. Ft.	x	0.08	= gpd
Department Store without Lunch Counter	Gross Sq. Ft.	x	0.04	= gpd
Banks	Gross Sq. Ft.	x	0.044	= gpd
Restaurants	# Seats	x	24.2	= gpd
Service Stations	Gross Sq. Ft.	x	0.18	= gpd
Laundries and Cleaners	Gross Sq. Ft.	x	0.31	= gpd
Laundromats	Gross Sq. Ft.	x	3.68	= gpd
Car Wash (without Recycle)	Gross Sq. Ft.	x	4.90	= gpd
Hotels	Gross Sq. Ft.	x	0.256	= gpd
Motels	Gross Sq. Ft.	x	0.224	= gpd
Hospitals	# Beds	x	346	= gpd
Theaters	# Seats	x	1	= gpd
Nursing Homes	# Beds	x	130	= gpd
Dry Goods Stores	Gross Sq. Ft.	x	0.048	= gpd
Shopping Centers	Gross Sq. Ft.	x	0.172	= gpd
Auto Dealership	Gross Sq. Ft.	x	0.078	= gpd
Barber Shop	Gross Sq. Ft.	x	0.20	= gpd
Carry-out (Except Major Chains)	Gross Sq. Ft.	x	0.20	= gpd
Carry-out (Chain)	# Seats	x	10	= gpd
Church	# Sanctuary Seats	x	4	= gpd
Garage (Auto/Truck Repair)	Gross Sq. Ft.	x	0.014	= gpd
Library	Gross Sq. Ft.	x	0.10	= gpd
Bakery	Gross Sq. Ft.	x	0.15	= gpd
Racket Club/Tennis Club	# Courts	x	300	= gpd
Pool (with Hot Showers)	# Members	x	6	= gpd
Pool (without Hot Showers)	# Members	x	4	= gpd

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Flow factors are for planning purposes only. Flow factors include inflow/infiltration. Actual capacity charge will be determined at the time of application for building permit. Use of these flow factors shall not be used in lieu of actual fixture counts (as defined in the Bureau of Water and Sewer Rules and Regulations) to determine capacity charges or any other fees.



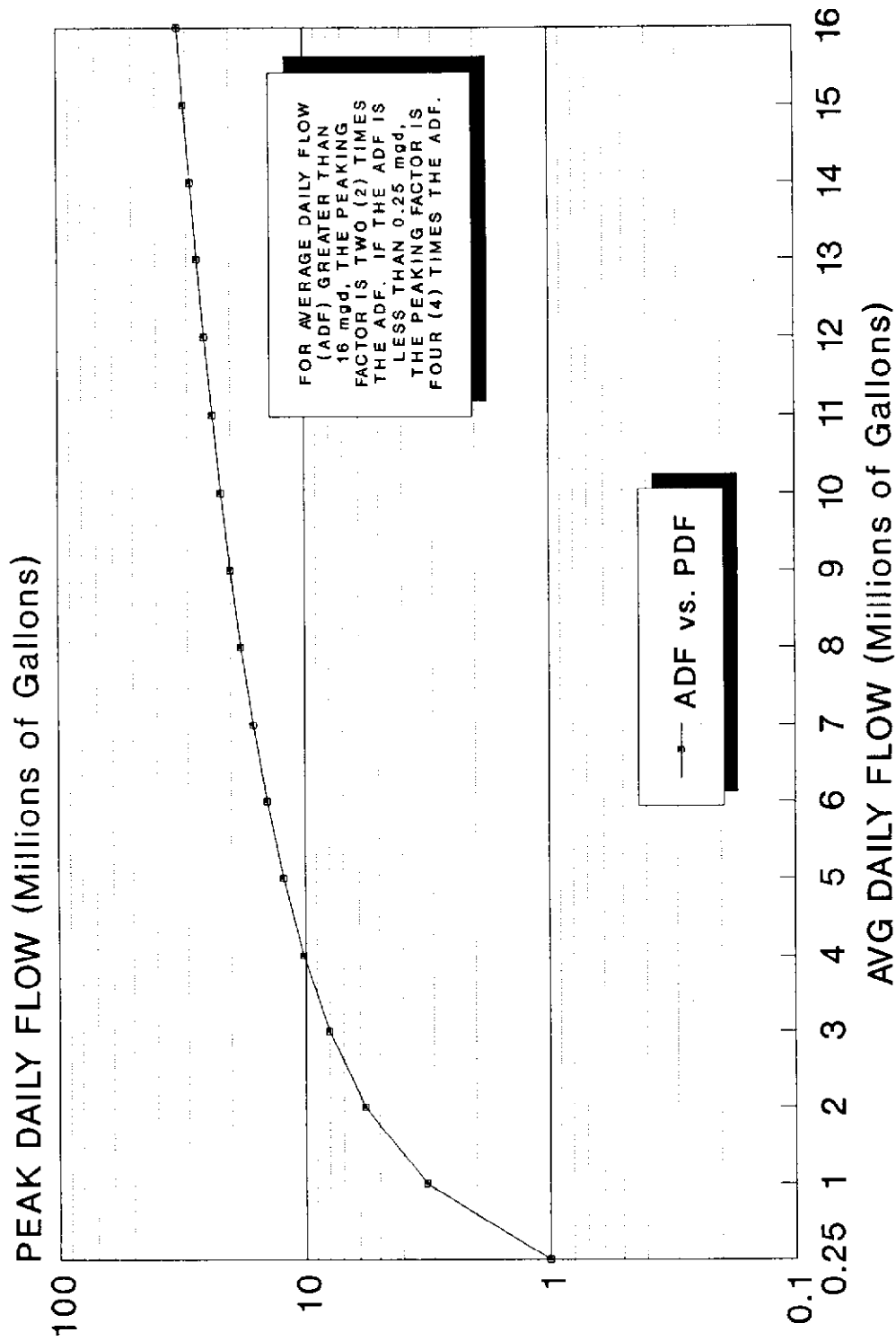
# Flow Factors (Continued)

<u>Zoning</u>	<u>Uses</u>	<u>Design Flow</u> (GPD)
R-1	General: Single family: Townhouse: Apartment:	100/person 370/d.u. 300/d.u. 300/d.u.
R-3		
R-5		
R-8		
R-12		
R-16		
PUD		
MH		
VC	General: Motel: Office:	2000/acre 130/unit 30/employee or 0.20/net sq.ft. whichever greater
GC		
HS		
LI	General: Warehouse: Other:	7500/acre 750/acre Varies with Industry
GI		
MM		
ORI		
School	General:	16/person

Flow factors are for planning purposes only. Flow factors include inflow/infiltration. Actual capacity charge will be determined at the time of application for building permit. Use of these flow factors shall not be used in lieu of actual fixture counts (as defined in the Bureau of Water and Sewer Rules and Regulations) to determine capacity charges or any other fees.

# MDE PEAK FLOW CURVE

## FROM 0.250 TO 16 MILLION GALLONS PER DAY



FREDERICK COUNTY BUREAU OF WATER & SEWER  
DIVISION OF ENGINEERING AND PLANNING  
FILE: \HG\PEAK2.CHT

**Project Name:**

Computed By: \_\_\_\_\_ Date: \_\_\_\_\_

[illegible]

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II Water and Sewer*, October 1980 and amendments through October 1990.

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   *BOCA National Building Code*  
   *Frederick County Plumbing Code*  
   *National Electric Code*  
   *NFPA Life Safety Code*  
   *Maryland Building Code for the Handicapped*

## COMAR

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